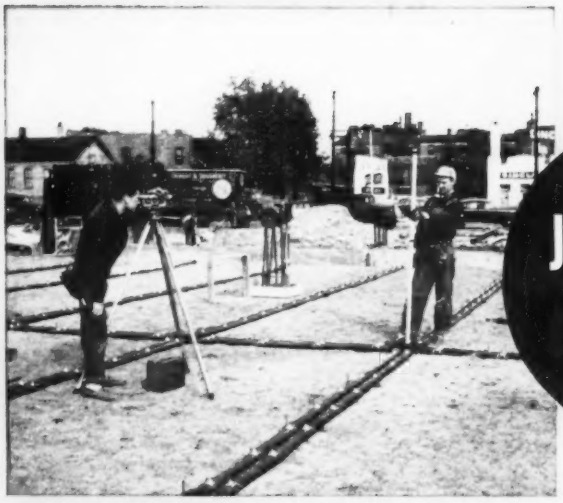
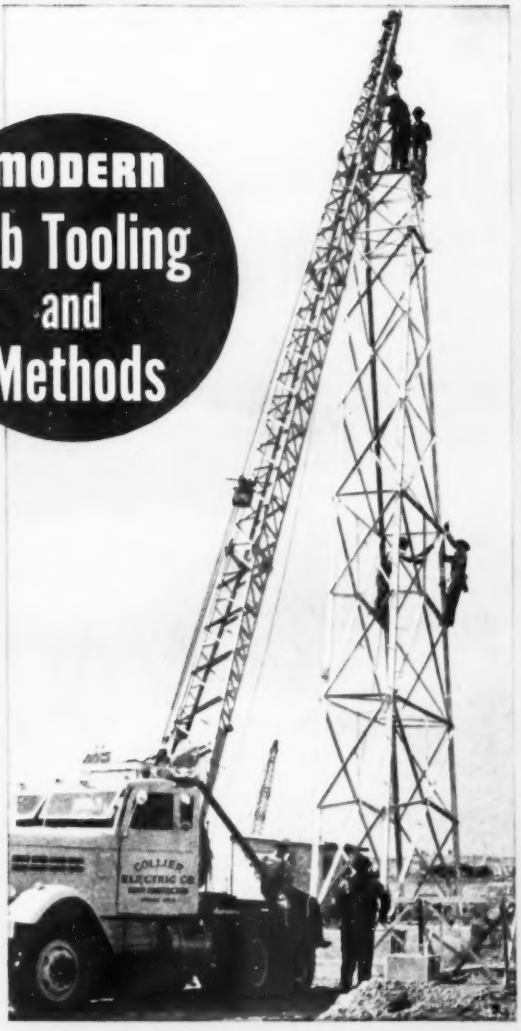
JULY 1953
PRICE 35 CENTS

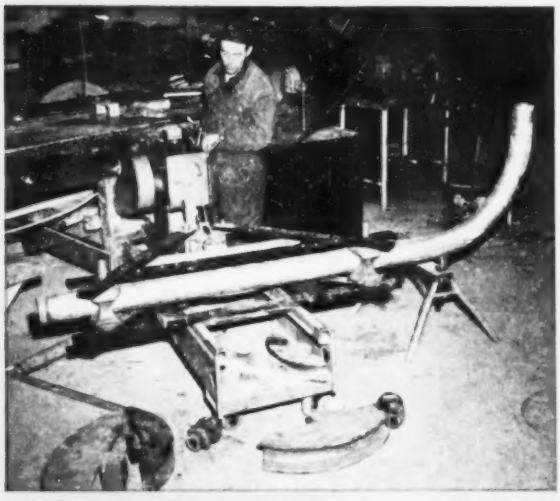
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



MODERN Job Tooling and Methods

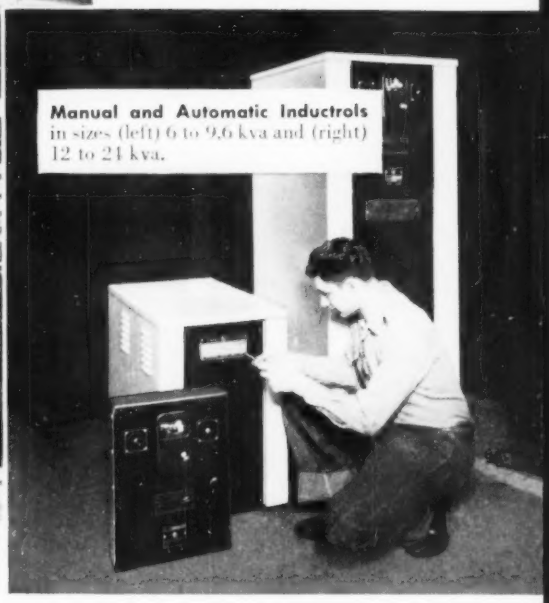




A ROUND-UP REPORT *on up-to-date industry practices in the use of specialized tools and methods for on-site fabrication, installation and erection of electrical systems and equipment, complete in this issue.*

A McGRAW-HILL PUBLICATION 52ND YEAR

FLUORESCENT LAMPS need constant voltage for maximum operating efficiency and lamp life.



Manual and Automatic Inductrols in sizes (left) 6 to 9.6 kva and (right) 12 to 24 kva.

Maximum equipment life—less operating cost with G-E voltage regulators

You can eliminate the harmful effects of undervoltage and overvoltage on your a-c electric equipment by installing G-E Inductrols. These dry-type regulators automatically maintain correct voltage and insure peak operating efficiency.

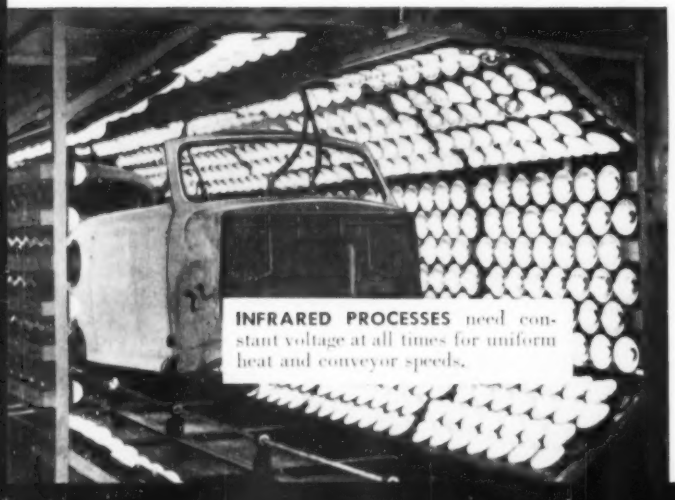
Standard automatic regulators are available for circuits from 3 kva, 120 volts up to 520 kva, 600 volts either single- or three-phase. For more information, contact your nearest G-E Sales Representative, or write for Bulletins GEA-5824, GEC-795 and GET-2351, General Electric Company, Section 423-202, Schenectady 5, New York.

You can put your confidence in—

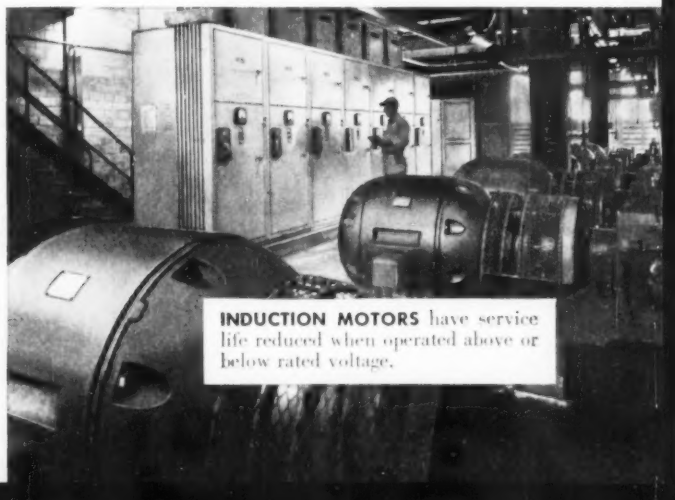
GENERAL ELECTRIC

WHY YOU NEED GOOD VOLTAGE

EQUIPMENT	10% UNDERVOLTAGE	10% OVERVOLTAGE
INCANDESCENT LAMP BULBS	Cuts light output 30% —slows production	Cuts life 70% — triples costs
A-C MOTORS	Overheat—ups maintenance costs	Lowers power factor —ups power costs
RESISTANCE HEATERS	Cuts heat output 19% —slows production	Overheats—ups replacement costs
ELECTRONIC DEVICES	Probably destroy gas-filled tubes	Only 5% over cuts tube life 50%
INFRARED PROCESSES	Ups process time —slows production	Blisters, scorches— ups production cost



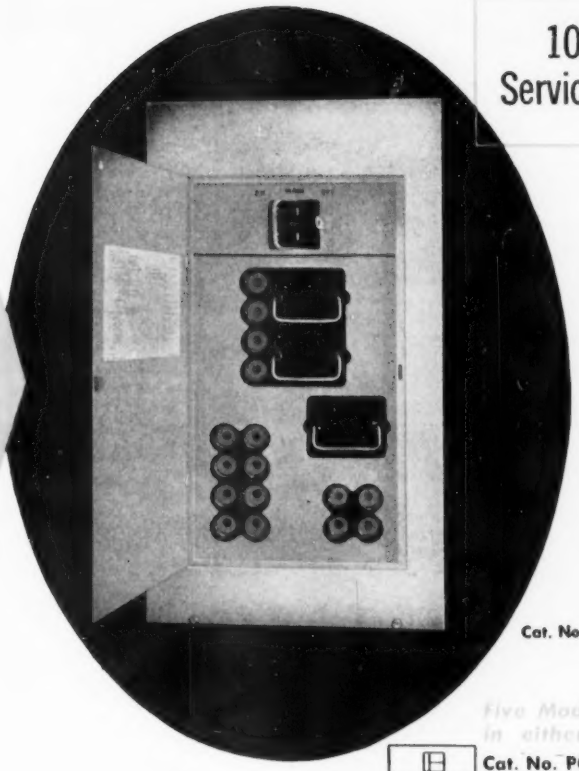
INFRARED PROCESSES need constant voltage at all times for uniform heat and conveyor speeds.



INDUCTION MOTORS have service life reduced when operated above or below rated voltage.

ANOTHER NEW Murray PRODUCT

100 Ampere Service Equipment



Cat. No. PC316A

HERE'S A "Packaged" SOLUTION TO INCREASING LOADS

Murray's "Combination" units will solve your main switch and distribution panel problems—

1 THEY PROVIDE BOTH SERVICE ENTRANCE AND BRANCH DISTRIBUTION IN ONE UNIT.

These Murray "Combination" service entrance and branch distribution units provide 100 Ampere main circuit breaker, fusible range and water heater pullouts, lighting and appliance plug fuse branch circuits—with or without a dryer pullout!

2 THEY PROVIDE FOR GROWING ELECTRICAL LOADS.

Any one of these five compact units offers a packaged solution to increasing loads. They are ideal for small commercial and large residential installations.

3 THEY SAVE TIME AND MONEY IN INSTALLATION.

Murray "Combination" units will save you time and money all along the line. Just one unit to *buy* – just one unit to *install* – just one unit to *wire!*

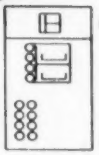
Factory bussing makes these units easy to wire. There's plenty of wiring room and all K. O's are conveniently located. Hook-on cover uses only two screws. Compact! Only 12-⅞ inches wide, designed to fit between building studs.

4 THEY GIVE DEPENDABLE CIRCUIT PROTECTION AT ALL TIMES.

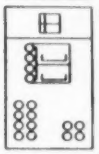
Fully magnetic circuit breaker main consists of two independent trip, 1 pole, 100 Ampere 120/240 volt AC fully magnetic circuit breakers. Carries full rated load continuously. Handle bar permits simultaneous manual tripping to "off".

Murray's well-known fusible pull-out construction provides positive electrical contact. One piece fuse clip and blade prevents overheating.

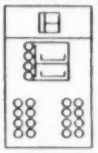
Five Models to Choose from in either surface or flush.



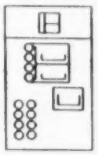
Cat. No. PC212A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
12 plug fuse branch circuits
List Price – **$59.00**



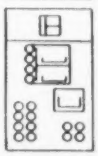
Cat. No. PC216A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
16 plug fuse branch circuits
List Price – **$69.00**



Cat. No. PC220A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
20 plug fuse branch circuits
List Price – **$80.00**



Cat. No. PC312A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
12 plug fuse branch circuits
List Price – **$69.00**



Cat. No. PC316A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
16 plug fuse branch circuits
List Price – **$76.00**

Murray®

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE • BROOKLYN 16, N.Y.

Service Entrance & Meter Equipment • Fully Magnetic Circuit Breakers • Switches (Types A, C and D)
Current Limiting Reactors • Crows' Nest Aerial Ladders

Type EFU—First and still finest Explosion-Proof Fluorescent Lighting Fixture. Available for two 40 Watt, 48" lamps or two 100 Watt, 60" lamps. Pat. No. 2,393,202

Industrialite High Mounting Fixture—For railroad yards, steel mills, round houses—any industrial plant calling for a ruggedly built, high-mounted lighting fixture.

BETTER LIGHT *for* BIGGER PRODUCTION

Stocklite—Provides perfect illumination for shelves and bins in stock rooms.

RLM Standard Dome Fixture—Reflector made of rust-resisting iron and finished with three coats of baked porcelain enamel. Sectionalized construction permits easy installation, convenient servicing.

Fewer rejections . . . greater safety . . . better employee relations . . . increased efficiency to meet defense demands—these are the immediate returns on an investment in good industrial lighting.

Appleton Industrial Lighting Equipment is precision-designed to provide *good light*—the right light, without uncomfortable glare, troublesome contrast or shadow. Expert engineering, unequalled manufacturing facilities and nearly a half century of experience are combined in each Appleton fixture to provide maximum efficiency at minimum installation, service and operating expense.

Appleton Lighting Fixtures are made to suit every industrial requirement—including hazardous locations—whether indoors or out. For the finest illuminating equipment or expert assistance on any lighting problem, contact Appleton—Standard for Better Lighting.

APPLETON INDUSTRIAL LIGHTING

Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

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APPLETON

OUTLET BOXES AND SWITCH BOXES

ELECTRIC

INDUSTRIAL LIGHTING EQUIPMENT

PRODUCTS

EXPLOSION-PROOF FITTINGS • REELITES

ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated Electrical Contracting, The Electragist and Electrical Record . . . Established 1901

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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Modern Job Tooling and Methods 69

The electrical construction industry's progressive shift to mechanization is narrowing the gap between a fairly static skilled labor supply and a record volume of construction work. This review of contractor power tooling and installation practices is offered as a guide to those who face the problem of controlling labor hours in the face of rising costs and more intensive competition.

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Complete data and stock insures exact coil reproduction; shop efficiency aided by modern office equipment; drip tank has new slant.

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Lighting fixture schedule; reference file for jobsite ordering; shipments protected by rust-inhibiting wrapper; portable floodlights have many applications.

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Answers to code questions including branch circuit protection; panelboard protection; grounding conductors; asbestos varnish cambric conductors; Section 4115; wiring for motels.

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JULY 1953 • Vol. 52, No. 7

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GENERAL-PURPOSE CONTROL

Fhp motor starter

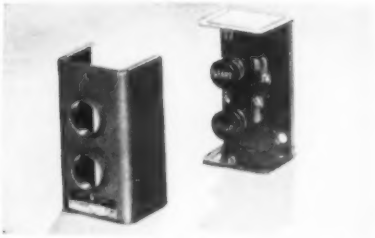
1—7½ hp manual motor starters

A-c magnetic motor starter

Combination motor starter

Reversing motor starter

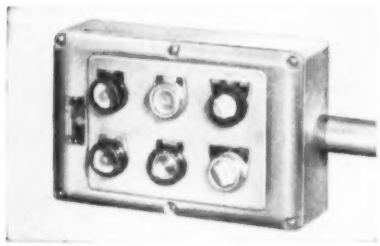
Choose from G.E.'s complete line of push buttons

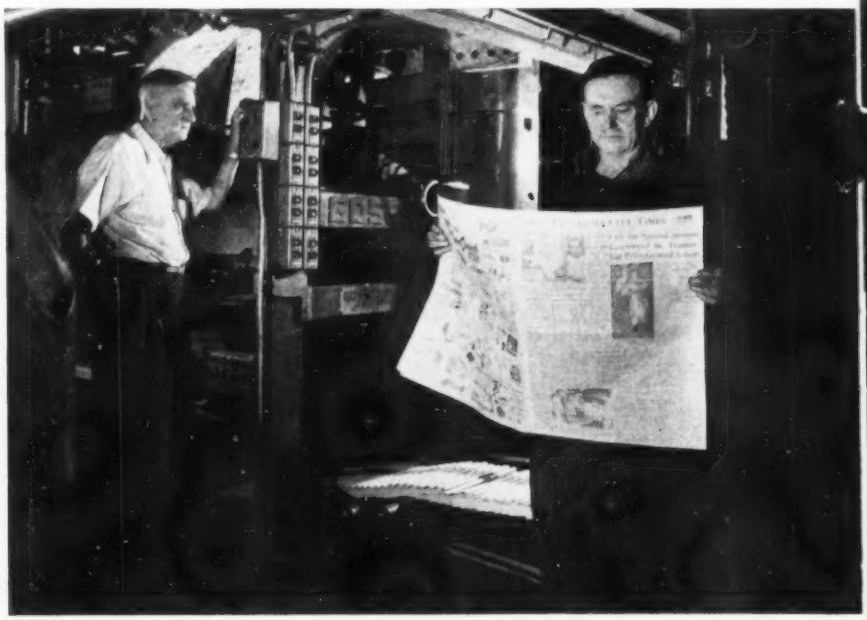

Standard-duty station, cover removed

Heavy-duty, for wall or flush mounting

Standard-duty watertight station

Standard-duty explosion-proof enclosure


Oiltight station mounted horizontally


General Electric push button installation at Oklahoma Publishing Company. Mounted on this newspaper press are eight heavy-duty stations of two units each together with a six unit oiltight station.

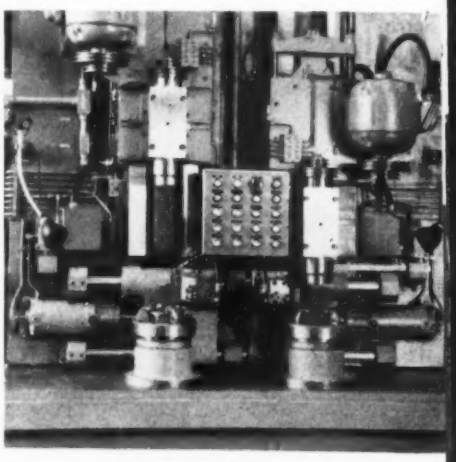
You'll find the right push-button unit or station for your particular application when you select a dependable G-E control accessory. All units have a continuous rating of 10 amps for all voltages.

THREE BASIC TYPES

Standard-duty—for average applications. Enclosures include general-purpose, dusttight, watertight, and explosion-proof. Over-all rugged construction includes fine-silver double-break contacts which make contact maintenance virtually unnecessary. And wiring is easy—front-connected terminals, ample space speed installation. For further details, write for Bulletin GEA-3469C.

Heavy-duty—designed to withstand the roughest industrial use. Contacts are heavier than in standard-duty forms; enclosures are heavier gage steel. Designed for maximum flexibility to provide for requirements which cannot be accommodated in standard-duty line. Forms are available with selector switches, indicating lights and maintained contact buttons. Forms for palm or foot operation are also available. Bulletin GEA-5043A gives complete details on these stations.

Oiltight—adapted to machine tool service or where oil or coolant is present. All stations meet JIC specifications in every detail. Strong, lightweight, cast aluminum enclosures are designed for convenient wiring. The units install easily and a specially designed washer keeps the units oiltight with normal hand tightening. Bulletin GEA-5779A gives ratings and complete information.


Twenty-unit G-E oiltight station on special hydraulic-actuated duplex machine built by Snyder Tool and Engineering Co., Detroit.

INFORMATION FOR CONTRACTORS-PLANT ELECTRICIANS

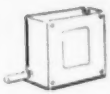
Reduced voltage starter

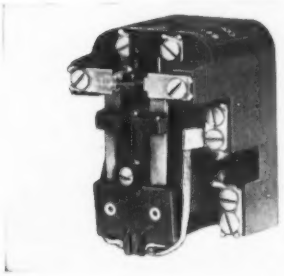
Heavy and standard-duty push-button stations

General-purpose relay

A-c and d-c solenoids

Roller-lever type limit switch

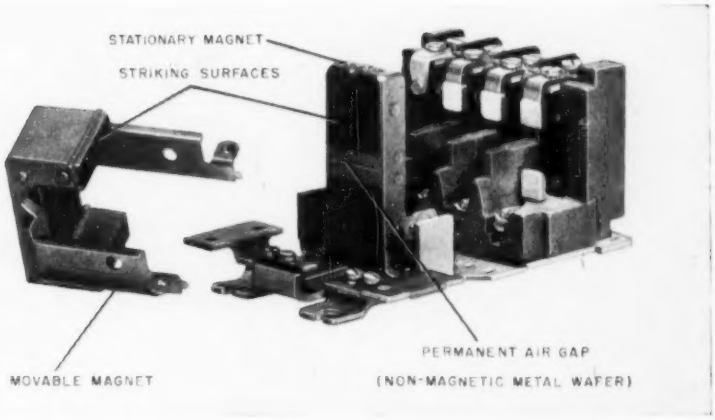

Rotating-type limit switch



NEW GENERAL-PURPOSE RELAY REDESIGNED FOR LONGER LIFE

The new CR2790E relay reduces your inventory—the basic relay and accessories meet a variety of applications. For general control-circuit applications, as a fractional-hp motor starter or, in combination with a magnetic switch, for controlling larger motors. Continuous current rating is 10 amps up to 300 volts on AC or DC. New long-life shunt assures top electrical performance. Bulletin GEC-257C lists available accessories, ratings and dimensions.

G-E MAGNETIC STARTER FEATURES PERMANENT AIR GAP



The G-E starter has a **permanent** air gap, a non-magnetic metal wafer mounted in a stationary magnet structure. Magnets never stick closed because of residual magnetism. The air gap is safely away from striking surfaces so the movable magnet cannot wear it down, no matter how often the starter is operated.

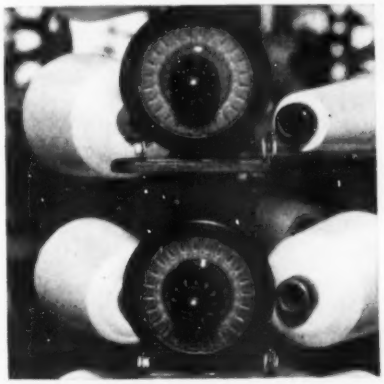
On some starters the air gap disappears as the magnets wear. With a G-E starter, however, you can be sure that every time you push the STOP button the magnet will drop out and stop the motor.

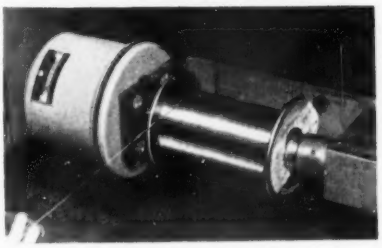
You're assured reduced maintenance, long mechanical life when you specify G-E magnetic starters.

NEW MAGNETIC BRAKE KEEPS TENSION CONSTANT

G.E.'s new tension brake—the first of its kind—is a magnetic device free of the basic disadvantages of friction devices, such as wide tension variations and undue wear. You'll find applications for the new brake wherever a constant tension is required—for yarns, rubber, glass fiber, and small diameter wire. Simple and compact, the brake holds tension constant at all speeds.

The size 200 brake has a torque range from 0.1 to 0.5 oz. in. and a tension range from 4 to 10 grams. Shown at the right in a textile application, the brakes are mounted on a magazine-type warping creel. The larger brakes, sizes 300 and 400, have a torque range of 1.4 to 14 oz. in. over a speed range of 0 to 1500 rpm. Write for Bulletin GEA-5867.





Size 400 tension brake in resistor wire-winding application. Increase or decrease tension by turning easy-to-read, calibrated adjusting cap.

NEW G-E STOCKING PLAN ASSURES PROMPT SHIPMENT

G.E.'s new Prompt Service program assures you faster, better service for your order. The program is based on perpetual stocking in your area, and prompt shipment of widely used general-purpose devices. You pay no premium for this service and you'll need no follow-up on these orders. You can reduce your control inventory. Check coupon for complete information.

General Electric Company
Section A730-46
Schenectady, N. Y.

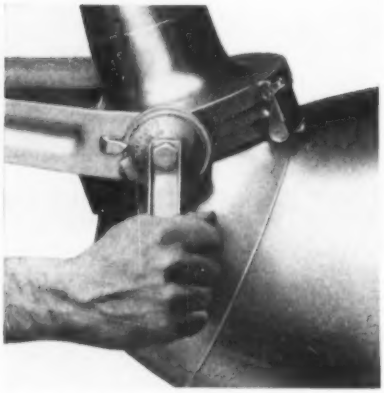
Please send me the Prompt Service Bulletin listing the general-purpose control devices stocked for immediate delivery in my area.

Name _____

Address _____

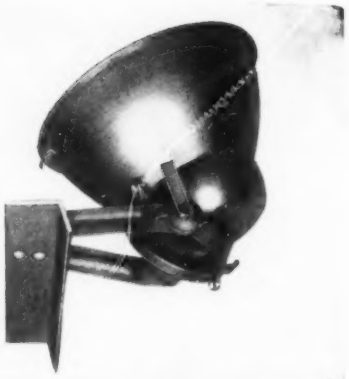
For more information contact your nearest G-E representative, agent, or distributor, or write Section A730-46, General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC



1 NO TOOLS required for initial positioning or maintenance with built-in wrench-type handle. Large area clamping action holds against vibration.

2 EASY AIMING is possible even during daylight with G-E L-69's convenient beam sight ... puts the light in the right place, cuts down on installation time.



3 EASY CLEANING to remove particles in case of lamp breakage is possible as the reflector tips over completely. No tools required for the operation.

5 reasons why G-E L-69 Floodlights cost you less to install and maintain

EASY INSTALLATION. You save money by saving time when you install economical G-E Type L-69 1500-watt Floodlights. From the simple two-bolt mounting to the convenient beam sight for fast daylight aiming, the lightweight G-E L-69 is designed so that it will cut your costs by simplifying your installation.

ECONOMICAL MAINTENANCE. Built-in wrench type handle on the G-E L-69 completely eliminates the need for tools. Both relamping and cleaning are fast and easy, and the G-E L-69 delivers more light per unit, more light per watt, than any other comparable lighting unit.

LONG LIFE. The G-E L-69 is constructed completely of aluminum and other non-corrosive metals which will stand up under all weather conditions. This long life construction will save you and your customers money, because it costs you less to maintain these floodlights. With the G-E L-69 you can do a quality lighting job that will pay off in more lighting business for you.

PROMPT DELIVERY. You can get the G-E L-69 right out of distributors' stocks at shipping points throughout the country. There's a light in G.E.'s complete line of open and enclosed floodlights to precisely fit your needs whatever your lighting requirements are. And if you need help, you can get it from G.E.'s staff of lighting specialists.

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

USEFUL INFORMATION is yours for the asking. NEMA approved floodlighting plans for all sports are contained in GET-1284; effective industrial uses are explained in GEA-3640D; and Bulletins GEC-533B and GEC-919 give complete details on the L-69 sports and area floodlight. Just write Section 451-183, General Electric Company, Schenectady 5, New York.

You can put your confidence in—

GENERAL ELECTRIC

4 LESS BREAKAGE with spun-on, impact resisting tempered plate glass, which won't break if struck by ball, and keeps water, dirt and insects out permanently.

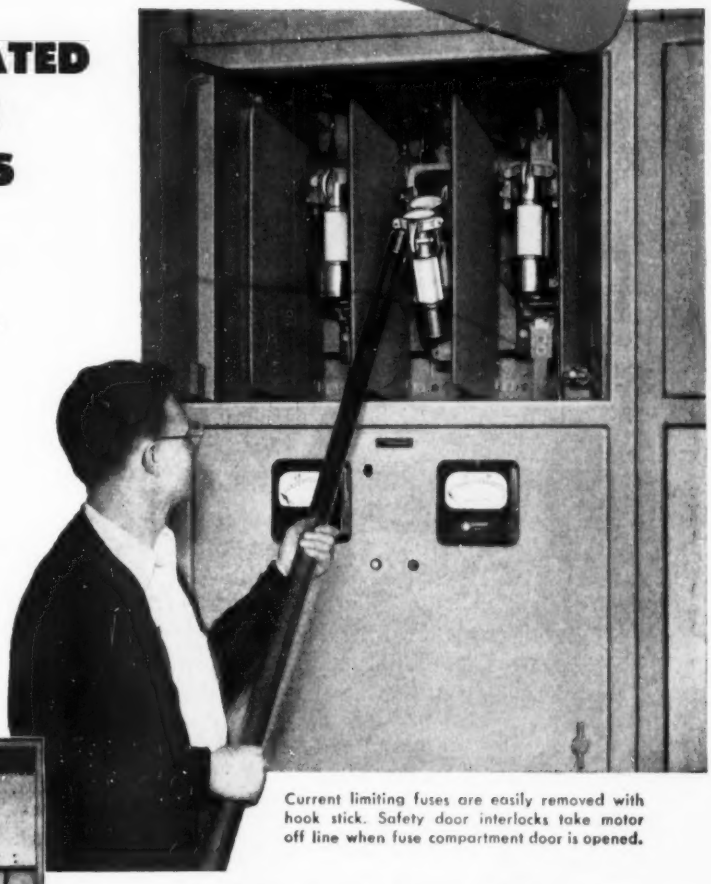
5 EASY RELAMPING. Flick hand toggle latches, clamp socket housing to trunnion bracket. Hands are free to service light. Reflector need not be disturbed.

Personnel Protection

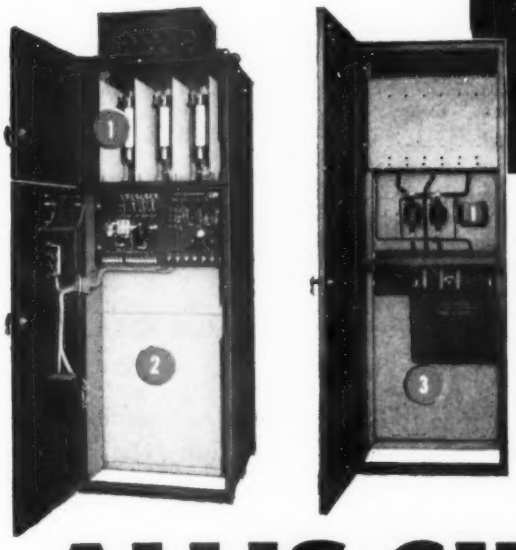
ALLIS-CHALMERS
Type H Starters
FOR 2300 TO 5000 VOLT MOTORS

THROUGH SEGREGATED HIGH VOLTAGE COMPARTMENTS

For positive personnel protection, high voltages are completely segregated in the Allis-Chalmers Type H starter. Full width, heavy sheet steel barriers separate the front low voltage compartment from the rear high voltage equipment and from the upper fuse compartment. It will pay you to get all the details from your nearby A-C representative or by writing Allis-Chalmers, Milwaukee 1, Wisconsin.



Current limiting fuses are easily removed with hook stick. Safety door interlocks take motor off line when fuse compartment door is opened.

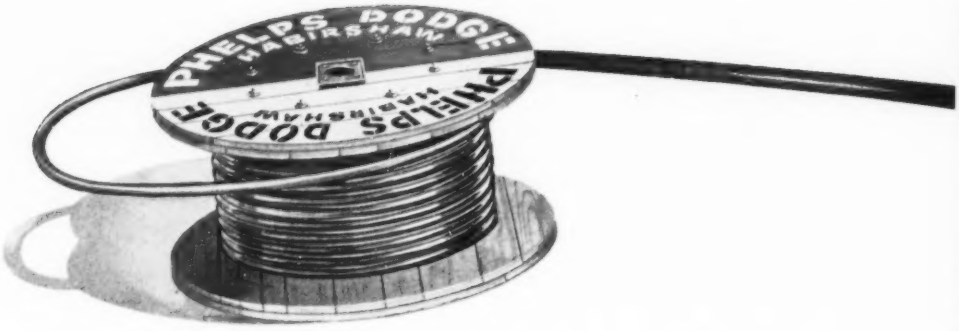


3 Compartments Assure Safety

The heavy gauge steel cubicle is divided into three compartments for maximum safety. **1** — Upper front compartment encloses disconnect type fuse. The same operation which puts fuse in position for removal isolates starter from line. **2** — Lower front compartment houses low voltage control devices. **3** — Rear compartment contains high voltage equipment, contactors, buses, instruments, transformers, etc.

A-4002

ALLIS-CHALMERS



WIRE BY PHELPS DODGE MEANS WIRED FOR LIFE!

Habirshaw Quality Goes Beyond Specification Requirements—is Checked by Exhaustive Controls and Tests!

Here one of many inspectors checks rubber-insulated cable for quality of workmanship.

Testing a sample of rubber-insulated cable for high-voltage breakdown strength.

HABIRSHAW building wire—product of Phelps Dodge Copper Products Corporation—helps build *your own* reputation for skilled, trouble-free installations. An exacting, direct inspection system continually double checks the high quality of Habirshaw materials and workmanship—to assure highest standards for long-life service.

See Your Phelps Dodge Distributor!

Habirshaw heat- and moisture-resistant, rubber-insulated cable, Type RH-RW, typical of quality workmanship that makes the name "Habirshaw" synonymous with *greater job profit* in wiring modern buildings.

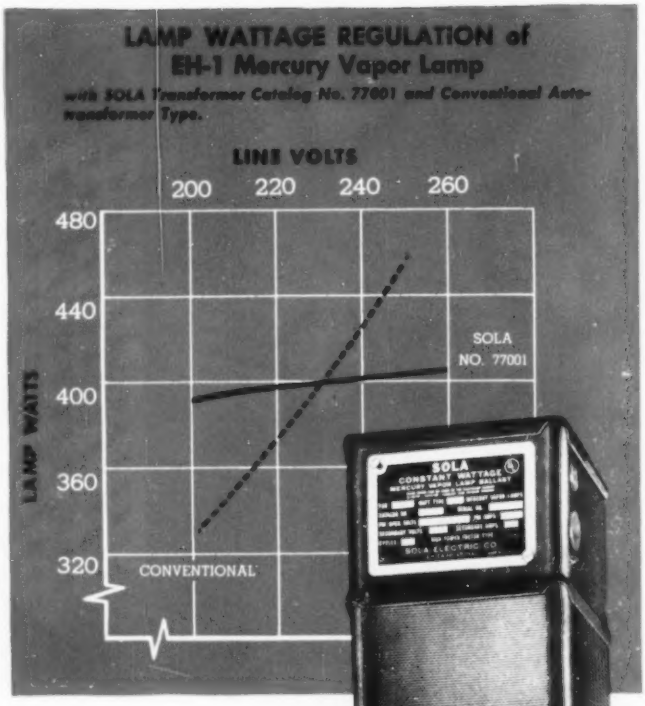
29 years of careful attention to the rigid control of quality—that's the record of this Phelps Dodge worker!

PHELPS DODGE COPPER PRODUCTS

CORPORATION

extended lamp life

for Mercury Vapor Lamps operating from SOLA Constant Wattage Transformers



INDOOR TYPE CONSTANT WATTAGE UNIT IS ILLUSTRATED HERE.

A direct relationship exists between proper input voltage and mercury vapor lamp efficiency and life. The following facts about this relationship were recently published in leading trade journals:

1. *Lamp life is shortened through overheating from 5% overvoltage.*
2. *Mercury vapor lamps extinguish with 15% undervoltage.*
3. *Light output is cut 15 to 25% with 10% undervoltage.*

Sola Constant Wattage Transformers continuously and automatically supply constant wattage within ±2% regardless of line voltage fluctuations as great as ±15%. This new application of the patented Sola Constant Voltage Principle assures operation of mercury vapor lamps under the same conditions for which they were designed, resulting in:

1. *Savings of lamp replacement cost, labor expense and inconvenience of relamping.*
2. *Dependability, since lamps will not extinguish until voltage drops to 75 volts.*
3. *Maintained light output constant within ±3% even with ±15% voltage fluctuation.*

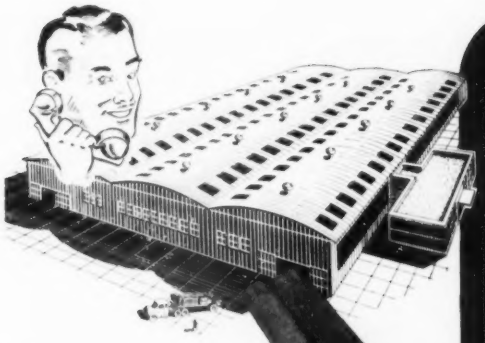
Regulated Outdoor

Regulated Indoor

Conventional Indoor

SOLA *Mercury Vapor Lamp* TRANSFORMERS

Transformers for Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Mercury Vapor Lighting • Luminous Tube Signs
SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois, Bishop 2-1414 • NEW YORK 35, 103 E. 125th St., TRafalgar 6-6464
PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre St., Newton 58, Mass., Bigelow 4-3354
CLEVELAND 15, 1836 Euclid Ave., Prospect 1-4488 • KANSAS CITY 2, MO., 406 W. 34th St., Jefferson 4887 • Representatives in Principal Cities



PITTSBURGH STANDARD
SALES CONTROL CENTER

CAN YOU GET CONDUIT DELIVERY INFORMATION

. . . immediately?

. . . accurately?

YOU CAN FROM PITTSBURGH STANDARD'S "SALES CONTROL CENTER"

HERE'S HOW THE "SALES CONTROL CENTER" SPEEDS YOUR PURCHASING

Pittsburgh Standard's Sales Control Center is the single coordinator for production, sales,and delivery information for all Pittsburgh Standard agents throughout the world. It completely eliminates "going through channels" . . . speeds purchasing immeasurably.

When you need information for your raceway requirements, your Pittsburgh Standard agent writes, wires or phones the Sales Control Center, and *facts*, not guesses, are ready for him immediately. He can quote you at once, price, delivery and pertinent details.

There is no longer any point to waiting long intervals for information on rigid steel conduit, E.M.T., elbows, couplings and fittings on which to base your bidding estimates and work schedules. Pittsburgh Standard products have a 50-year reputation as the "Standard of the Trade". Here, indeed,is Service to match that Quality.

YOUR PITTSBURGH STANDARD AGENT

PITTSBURGH STANDARD CONDUIT CO.

WHOLESALERS IN PRINCIPAL CITIES

RIGID STEEL CONDUIT
all finishes
ELECTRICAL METALLIC TUBING
ELBOWS
COUPLINGS
FITTINGS

61 BRIDGE ST., PITTSBURGH 23, PA. • PLANTS at MORRISVILLE and ETNA, PA.

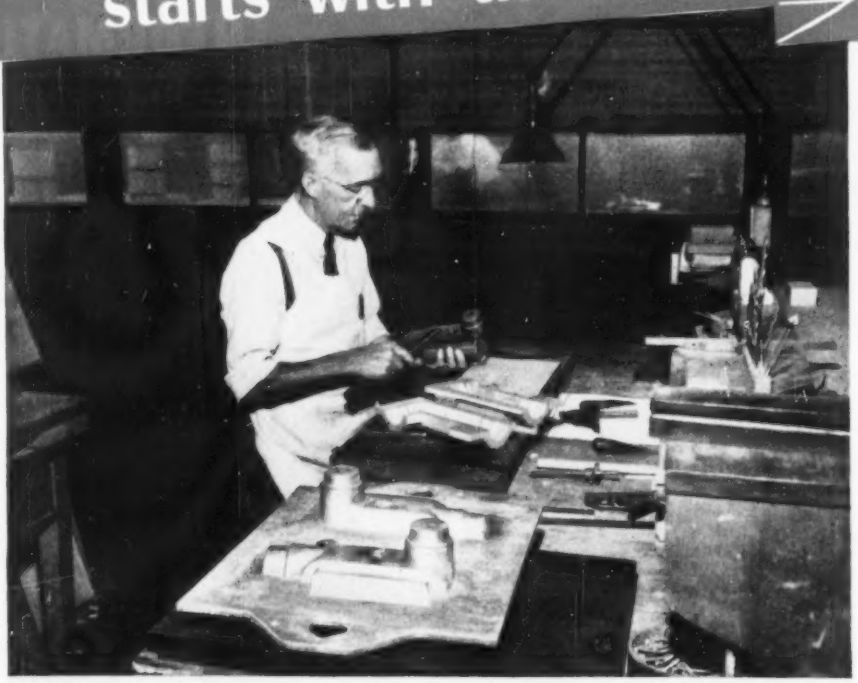
CROUSE-HINDS quality starts with the casting

Type FLB Explosion-Proof
Circuit Breaker Condulet

Type ARE Plug Receptacle
With Spring Door

Type GUAC Explosion-Proof
Junction Condulet

Type LB
Obround Condulet



1. A highly skilled patternmaker, with long years of experience in precision craftsmanship puts the finishing touches on an Obround CONDULET master pattern.

They're made right to serve you better.

Working from designs that have been carefully developed in the Engineering Dept., expert patternmakers make the master patterns. Perfect workmanship is a tradition in Crouse-Hinds Pattern Dept., where half the workers have records of from twenty-five to more than forty years of service.

Crouse-Hinds Iron Foundry is one of the largest and best equipped of its kind. It has the latest mechanical improvements to enable the skilled molders to produce the best possible castings. Most CONDULETS are made of Feraloy, Crouse-Hinds special alloy having the desirable characteristics of both cast steel and gray iron. It is strong, tough, holds its shape, is inherently corrosion resisting, homogeneous, and machines well, giving sharp, full threads.

To maintain Crouse-Hinds high standard of quality there is constant checking and testing. In the Foundry Control Laboratory, core and molding sands and oils are examined. Only the best are used. Continual temperature readings of molten Feraloy are taken, and test bars are made and tested for strength in the Mechanical Laboratory. The Chemical Laboratory makes daily analyses of the Feraloy output of the foundry.

Crouse-Hinds Non-Ferrous Foundry is equipped to turn out high quality castings of aluminum, bronze, and other metals.

When quality counts use CONDULETS. They're made right . . . to serve you better . . . and last longer.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES — Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angles — Milwaukee — Minneapolis — New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington.
RESIDENT REPRESENTATIVES — Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS • TRAFFIC SIGNALS

. . . and goes thru every step

That's why CONDULETS* last longer

2. Expert molders operate the molding machines in Crouse-Hinds modern foundry. Sand hoppers are shown at top.

3. Molten Feraloy is poured into the molds from a distributing ladle in Crouse-Hinds mechanized foundry.

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CONDULET
First in the field
STANDARD OF QUALITY

A Nationwide Distribution Through Electrical Distributors

FLOODLIGHTS • AIRPORT LIGHTING

Save threading time with Youngstown Buckeye Conduit

ON-THE-JOB JOURNEYMAN KNOWS BUCKEYE FROM EXPERIENCE: "My boss learned that extra time spent on threading and rethreading a batch of poor quality conduit is money wasted. That's why we use only Youngstown Buckeye rigid steel conduit now. When we work with Buckeye, threading goes fast and easy because high quality steel gives perfect threads every time."

ELECTRICAL INSPECTOR HAS HIS SAY: "As far as I'm concerned, poor threads open the way to troubles. One way to avoid poor conduit threads is to get the best steel available. In my opinion, that's Youngstown Buckeye standard threaded rigid steel conduit."

Youngstown manufactures full weight rigid steel electrical conduit from start to finish. This enables Youngstown to control the complete manufacturing process from ore to final inspection, which insures that each length of Buckeye conduit is made of top-grade steel. High grade steel makes perfect threading easier, saves time and money. On your next job, be sure you get Youngstown Buckeye full weight standard threaded rigid steel conduit.

Shipments of Buckeye rigid steel conduit are now being made from our conduit mills at Indiana Harbor and Youngstown.

QUALITY V YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel

Export Office-500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.

Ramset
FASTENING SYSTEM

REDUCES PRICES

on Tru-Set Fasteners

Good news for users and prospective users of powder-actuated fastening!

Effective immediately, list prices on the RAMSET Tru-Set Fasteners are reduced, in some cases as much as 20%. Both light-duty drive pins and studs are included in this new move to increase the value of RAMSET SYSTEM for fastening into steel and concrete.

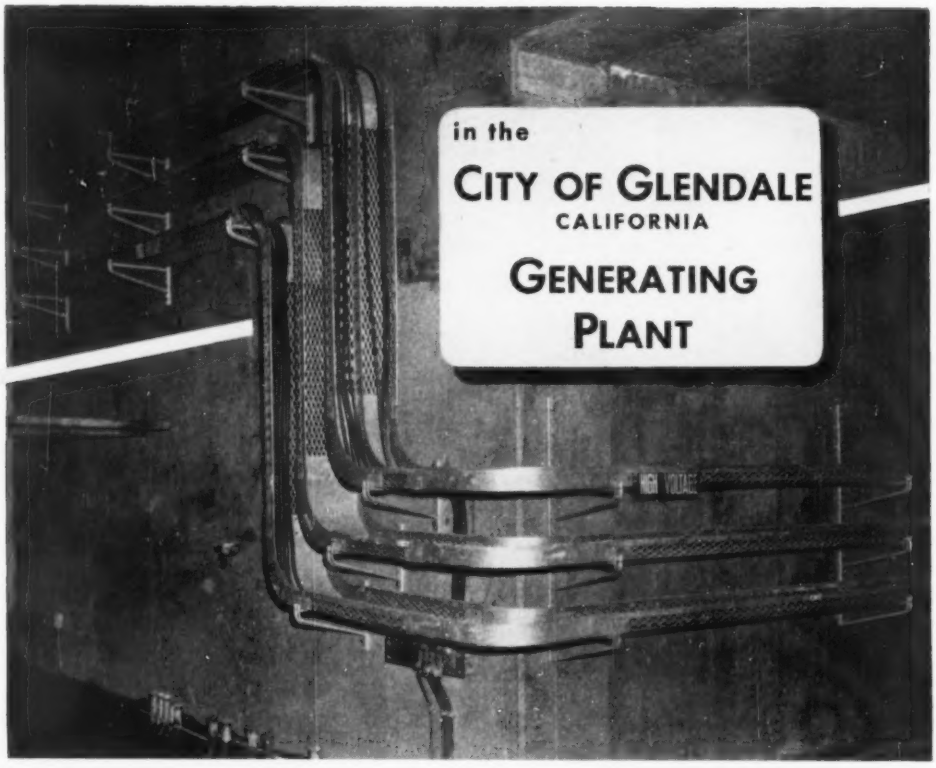
Most Versatile Line of Powder-Actuated Fastenings

Tru-Set Fasteners, with 56 sizes in 5 types to meet specific job requirements, have always offered the widest selection in the industry. Now, with these new, lower prices, and with the many built-in advantages of the Super-Speed JOBMASTER tool, users of RAMSET SYSTEM can still further cut their fastening costs.

Call your RAMSET Dealer for details on these cost reductions. And, if you are not already using the JOBMASTER, let him demonstrate its ease, speed, utility and economy.

***Ramset Fasteners,* INC.**
Ramset Division, Olin Industries, Inc.
12117 BEREA ROAD • CLEVELAND 11, OHIO

ANOTHER Olin PRODUCT



Cope CABLE TROUGH AGAIN PROVES ITS

... Simplicity of Installation
... All-around Economy
... Accessibility to Cable

The versatility and simplified design of the Cope system of Cable Trough and Fittings make it readily applicable to any layout. This is clearly seen in the above photograph showing part of a recent installation at the Glendale Generating Plant. Notice how the Cope Trough is supported by simple wall brackets. Observe, too, that both vertical and horizontal runs are made with standard trough and fittings — turns, branches and reductions.

The High Voltage sign on the top tray emphasizes another Cope Trough feature. Here 480 volt Neoprene jacketed power cables are carried in the same tray with control cables. A barrier strip provides adequate separation while permitting easy access to the lines. The lower tray will carry 2400 volt Neoprene jacketed power cables and ultimately will be equipped with a solid Cope Trough cover. Future expanding needs will be met by adding a fourth tray above the other three.

Learn how you, too, can cut cable installation costs and labor . . . write for bulletin on Cope Cable Trough.

T.J. Cope INC.

You know Cope by these products

711 SOUTH 50th ST., PHILADELPHIA 43, PA.

Approved by **UNDERWRITERS LABORATORIES**

YES, the PENN-UNION Connector TAKES THEM ALL-

LARGER SURFACES for the WRENCHES ~ a good-sized HEX Top and Bottom

The men who use connectors appreciate the *better design* of the Penn-Union - - especially when they have to make a splice in close quarters, or any unhandy location.

Better Design is a feature of the entire Penn-Union line, which includes Tees and Taps, Straight Connectors, Terminals, Grounding Clamps, and many more fittings . . . every one thoroughly dependable, mechanically and electrically. *Preferred by leading users,* who have found that "Penn-Union" on a fitting is their best guarantee of unfailing service.

Far More in use than any other

Sold by Leading Wholesalers

PENN-UNION ELECTRIC CORPORATION, Erie, Pa.

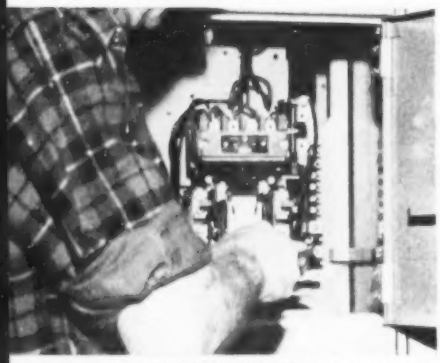
Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto

The Complete Line of Conductor Fittings

PENN-UNION

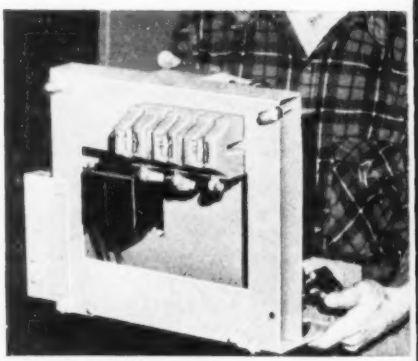
ENGINEERED FOR YOU, the new G-E motor control center is the result of intensive field surveys which told us what industry wants most. It provides maximum flexibility (units easily interchangeable) for central control of a-c motors up to 200 horsepower.

Here are Six Reasons for Specifying the New G-E Motor Control Center

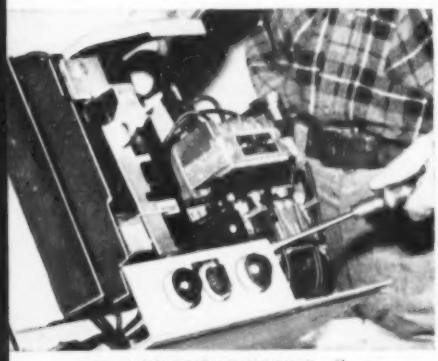


1 FOUR-INCH TROUGH for incoming power lines; terminals in front for easy wiring, maximum accessibility.

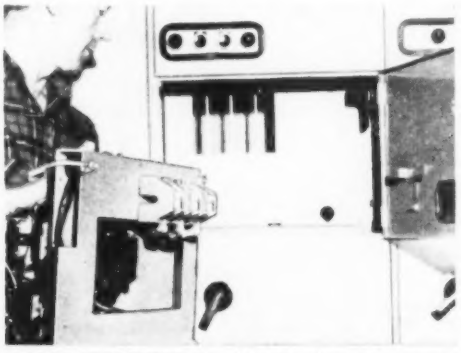
2 UNITS EASY TO CHANGE. To remove, disconnect terminals, pull unit out. Units easily changed since *all* components are on unit frame.



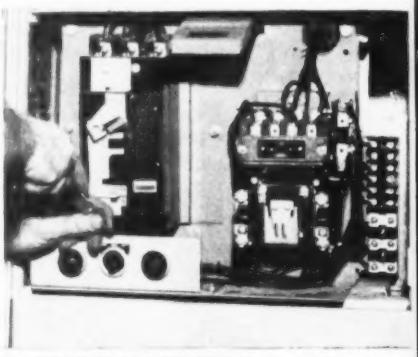
3 LIGHTWEIGHT UNITS are compact and easy to handle. This Size 1 starter unit weighs only 30 pounds.



4 ACCESSIBILE WIRING. Contactors, relays, pushbuttons, and breaker are easily accessible from all four sides.



5 BUS PROTECTED. Steel barrier keeps personnel away from bus. For added safety, compartment doors can be closed while unit is out of compartment.



6 DISCONNECT POSITION cuts unit power off; bus connections made automatically in operating position.

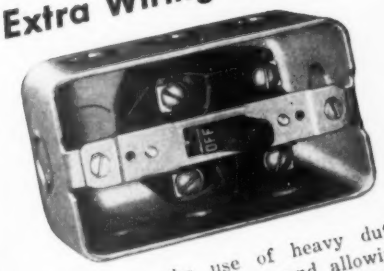
FOR FURTHER INFORMATION, contact your nearest G-E Apparatus Sales Office or authorized G-E distributor, or write Section 731-2 for Bulletin GEA-4979A today. General Electric Company, Schenectady, New York.

You can put your confidence in—

GENERAL ELECTRIC

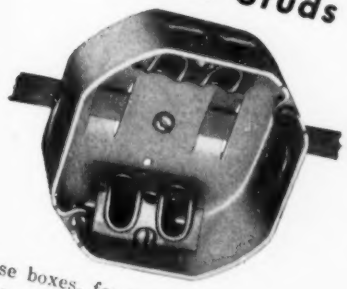
WHAT'S NEW at Steel City

Two New UTILITY BOXES with Extra Wiring Space



Permitting the use of heavy duty switches or receptacles and allowing ample space for easy wiring. For these boxes are six overlapping covers.

Four New BAR-SET BOXES Without Studs



These boxes, for non-metallic conduit and armored cable, are held in position on the bar with set screws and are priced for a saving when studs are not needed.

A New Line of INSULATING BUSHINGS

that meet, in full, the requirements of the National Electric Code and help to do

BETTER JOBS QUICKER

at a lower cost

. . . and This Book

giving detailed and well-illustrated information on Steel City Switch Boxes, is yours for the asking.

For more information on these new items and a copy of the Switch Box Book, fill in and mail the coupon.

STEEL CITY ELECTRIC COMPANY

Please send us . . .

- ☐ Copy of Switch Box Book
  More information on . . .
- ☐ New Utility Boxes
- ☐ New Bar-set Boxes
- ☐ New Insulating Bushings

Name .....

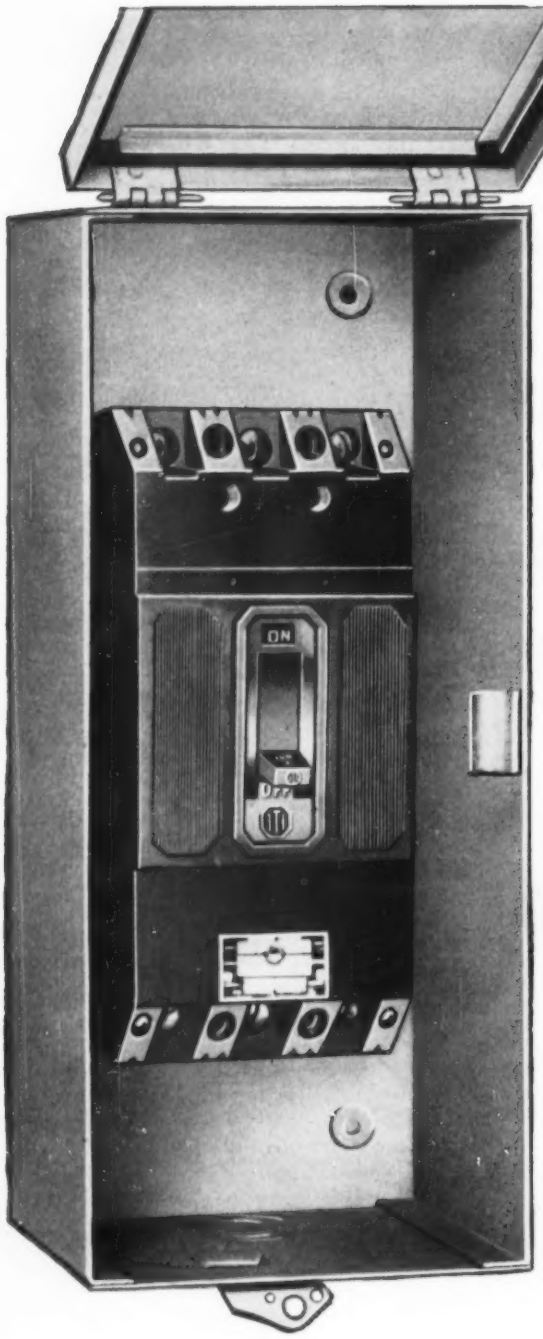
Address .....

STEEL CITY ELECTRIC CO.

PITTSBURGH 33 PENNSYLVANIA

ELECTRICAL BOXES AND CONDUIT FITTINGS

KINDORF DEVICES FOR INSTALLING CONDUIT

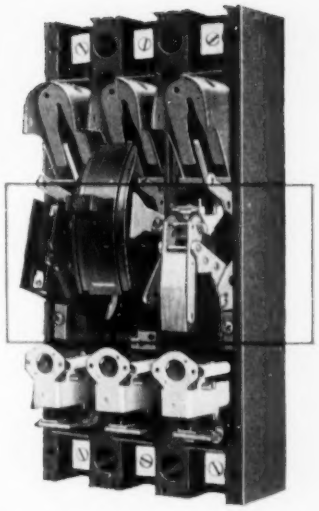


so MUCH more

for so LITTLE more

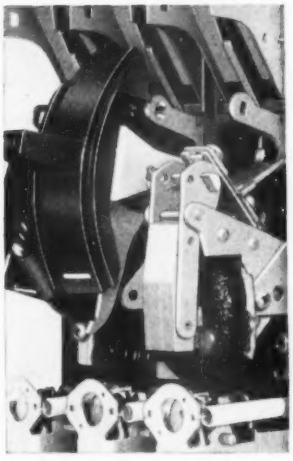
— I-T-E **INDIVIDUALLY ENCLOSED**

when you install I-T-E Circuit Breakers with *internally mounted* extra-protective devices



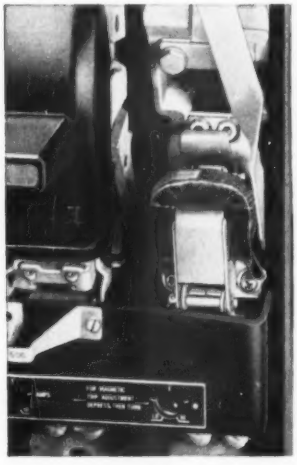
Many applications and processes impose requirements that cannot be met by standard types of electrical protective devices. When you select I-T-E Molded Case Circuit Breakers, however, you have a complete range of special-application auxiliary devices to choose from. The devices fit *right inside the molded case of the circuit breaker!*

I-T-E Circuit Breakers are available with special auxiliary devices—



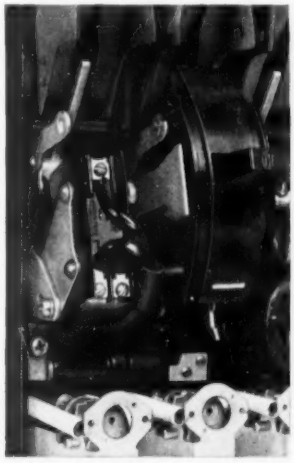
For control of electrical service from any remote point

The I-T-E *Shunt Trip Device* allows one or all critical circuit breakers to be tripped at the push of a button from a control point anywhere on the premises.



For protection against voltage loss

Any unusual voltage drop can be dangerous and costly. The I-T-E *Undervoltage Trip Device* automatically and instantaneously trips the circuit breaker, if voltage drops below a predetermined value. Equipment is protected against possible damage. Personnel are protected too, since equipment won't function until breaker is reset and closed.



For indication of condition of any critical circuit

I-T-E *Auxiliary Switches* can operate indicating lights mounted in any convenient location. Operators can see at all times whether the circuit is ON or OFF.

For signaling upon interruption of critical circuit

If the circuit breaker automatically trips for any reason, the *Bell Alarm Switch* is immediately closed to sound horns or light lights. Attention is attracted to the tripped breaker immediately.

From the 100-ampere "F" frame size —up to 600 amperes, 600 volts

I-T-E extra-protective auxiliary devices can be supplied to meet individual application requirements. Specify I-T-E Molded Case Circuit Breakers. They give you so *much* more—for so very *little* more.

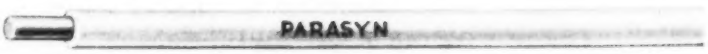
Your local I-T-E Distributor can give you full details. Or, if you prefer, write for *Bulletin 5004D. I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.*

CIRCUIT BREAKERS

IF IT'S PARANITE®
IT'S the RIGHT Wire and Cable

PARAFLEX Non-Metallic Sheathed Cable lays flat. Won't squirm or twist. Clean to handle. Plainly marked.

PARASYN® TypeTW Thermoplastic Wire stands exposure too severe for rubber insulated wires. Smaller diameter.



PARAUSE® Type "RR" Cable provides permanent underground installation from power line to meter and for connecting several buildings.

HYDRO-THERM® Building Wire combines in a single wire the heat-resistant qualities of Type RH and the moisture resistant qualities of Type RW.

URC Weatherproof Wire and Cable can be relied upon to meet severe climatic conditions. Both actual line and Weather-Ometer tests prove unusual ageing characteristics.

SERVICE ENTRANCE CABLE, Type SE Style U unarmoured and Type SE Style A armoured. There is also a Paranite Service Drop Cable, two conductor, Type SD.

DREADNAUGHT® Heavy Duty Cable has lead-cured neoprene insulation. Flexible, durable, safe, long-lived. Cuts repairs and replacements. Delivers current continuously.

IF IT'S PARANITE® IT'S RIGHT!

PARANITE WIRE AND CABLE
Division of ESSEX WIRE CORPORATION
FORT WAYNE 6, INDIANA

WIRES AND CABLES SINCE 1890

WAREHOUSES* AND SALES OFFICES: *Atlanta, Ga.; Boston, Mass.; *Chicago, Ill.; Cleveland, Ohio; Dallas, Texas; *Detroit, Mich.; Hartford, Conn.; Indianapolis, Ind.; *Kansas City, Mo.; Los Angeles, Calif.; Minneapolis, Minn.; Newark, N. J.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Ore.; Providence, R. I.; Richmond, Va.; San Francisco, Calif.; Seattle, Wash.; St. Louis, Mo.; Syracuse, N. Y.

EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 13 E. 26th ST., NEW YORK 10, N. Y.

ELECTRICAL WIRES AND CABLES *"BETTER THAN CODE REQUIRES"*

As fundamental as built-in cupboards...

No electrical contract is really complete unless it contains raceways for telephone wires.

Details in construction add a great deal to a home's convenience, whether these details are built-in cupboards and closets, or built-in telephone raceways.

Home buyers have come to expect concealed telephone wires.

Including telephone outlets and raceways in your contracts is a service to builder and buyer alike—*and a source of extra profit for you.* It may be a detail. But it adds much to the convenience, the beauty and the salability of the homes you wire.

BELL TELEPHONE SYSTEM

ONLY UNDER DIRECT FLAME, will GE's new self-extinguishing insulation for metal-clad switchgear char—as demonstrated in this picture with flame of blow-torch applied directly to the new laminated sheet-type insulation.

GE's "self-extinguishing" insulation gives

New sheet-type material with exclusive, flame-retardant feature localizes damage that may occur under abnormal conditions

The equivalent of a "built-in fire extinguisher"—a flame-retardant insulation for switchgear, marks the most recent General Electric development for even safer, more dependable metal-clad switchgear—industry's standard for 2400- to 13,800-volt circuits.

In introducing this flame-retardant insulation—which was perfected by Nicholas F. Arone, engineer in its Switchgear Department in Philadelphia—G.E. has gone far to minimize all potential fire hazards in switchgear.

All good insulating material has three standard properties: high mechanical strength, high dielectric strength, and a non-hygroscopic quality. To this group, G.E. is the first to add an important fourth property: a self-extinguishing characteristic that *refuses to sustain combustion.*

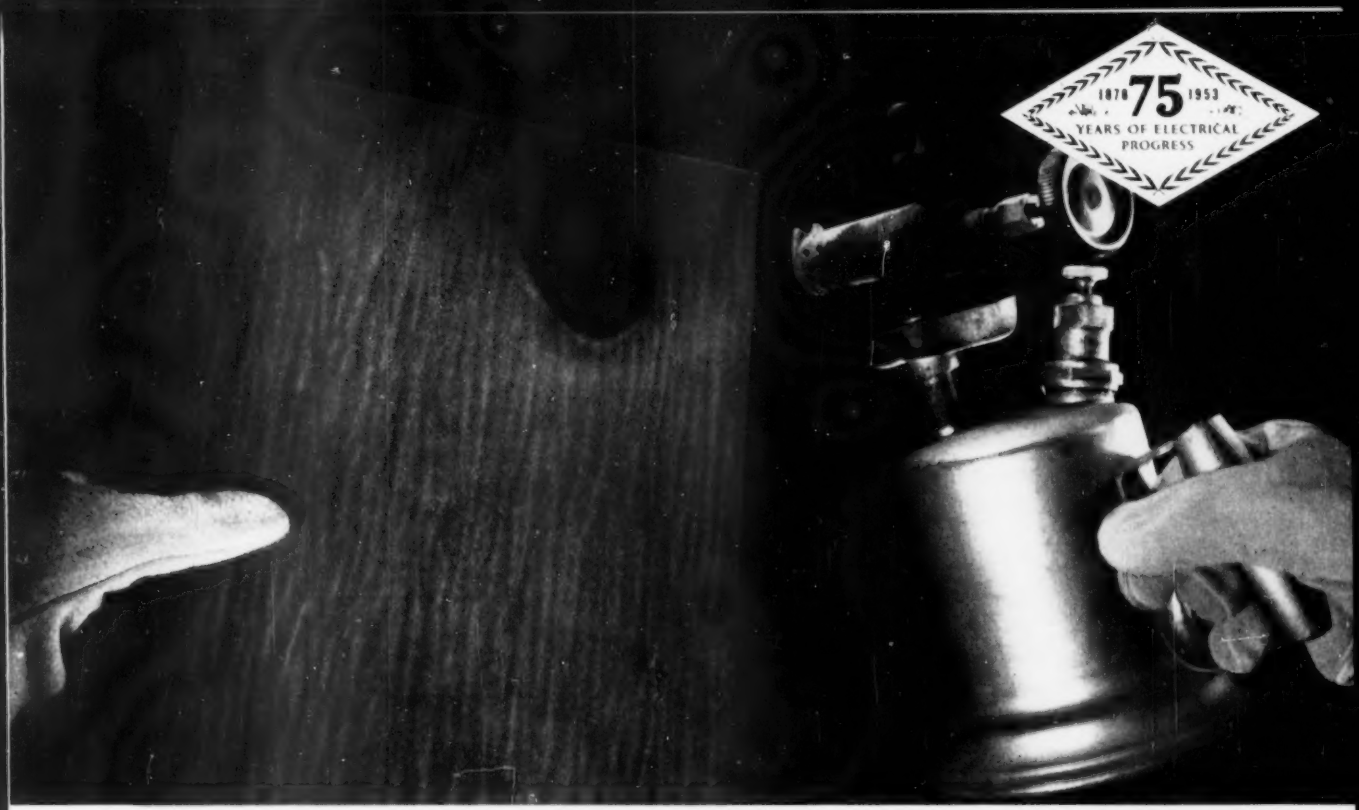
The laminated insulation sheet will burn and char—but *only* if an outside source of flame remains in contact with the sheet itself. Once the source is removed, polyvinylchlorides "smother" the flame in less than a minute—localize damage—and permit quick access to compartments for inspection and maintenance.

In bus and cable supports, in insulating barriers between compartments, in box barriers for arc chutes—throughout vital spots of metal-clad, GE's new flame-retardant insulation works for greater protection under *all* conditions—without extra cost to you.

For information on improved Metal-Clad Switchgear, with new, flame-retardant insulation, call your nearest G-E sales representative, or write to General Electric Company, Schenectady 5, N. Y. 8743

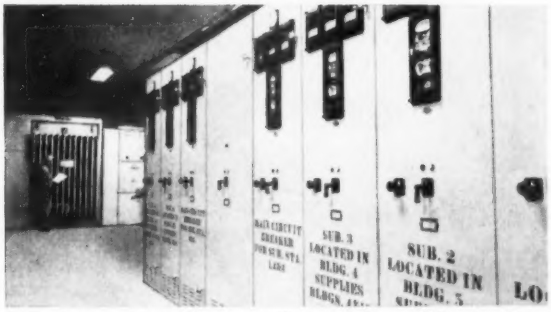
G. E. BURENS, *general manager, Switchgear and Control Division, presents Coffin Award to N. F. Arone for development of outstanding new insulation. Coffin Award is General Electric's highest employee honor.*

GENERAL ELECTRIC



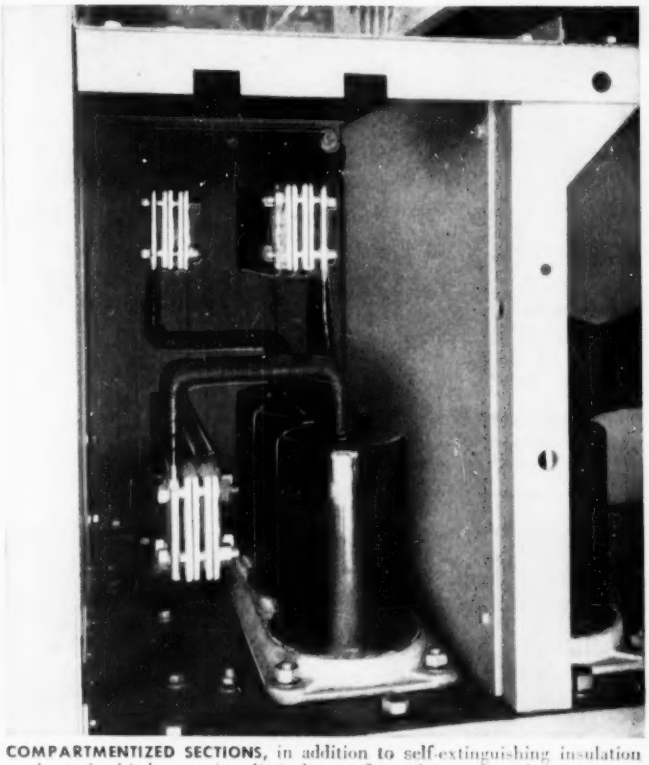
WITH FLAME REMOVED, the flame-retardant insulation refuses to sustain combustion—and extinguishes itself in less than 60 seconds. Polyvinyl-chlorides in the laminated sheet "smother" the flame, permitting ready access to compartments for inspection and maintenance.

added protection to metal-clad switchgear



THIS METAL-CLAD SWITCHGEAR lineup features GE's new flame-retardant insulation at vital points throughout all sections.

INSULATING BARRIERS for arc chutes are flame-retardant, non-hygroscopic, possess high mechanical and dielectric strength.

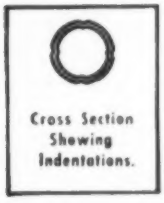


COMPARTMENTIZED SECTIONS, in addition to self-extinguishing insulation as shown in this bus section, limit damage from abnormal conditions.

USED THE MOST FROM COAST TO COAST

For many years Contractors from Coast to Coast have used Briegel All Steel Indenter Fittings. U. L. approved as concretetight and for general use, B-M Indenter Fittings are faster, easier to use and neater in appearance.

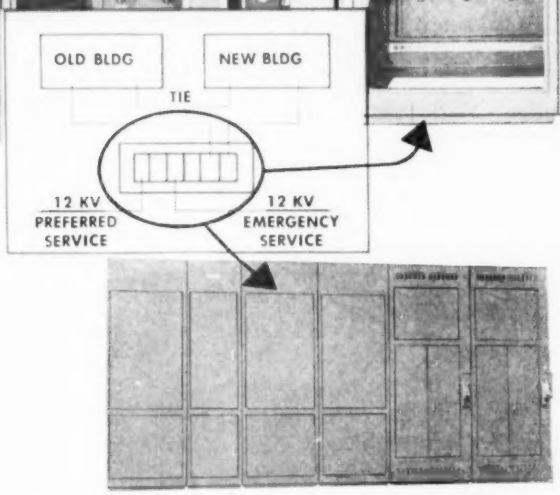
Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!



BRIEGEL METHOD TOOL CO.
GALVA, • ILLINOIS

Distributed by

Clayton Mark & Co., Evanston, Ill.; Nikoh Tube Co., 5000 South Whipple St., Chicago Ill.; Clifton Conduit Co., Jersey City, N. J.; The Steelduct Co., Youngstown, Ohio; Columbia Cable & Electric Corp., 255 Chestnut St., Brooklyn, N. Y.; Pittsburgh Standard Conduit Co., Pittsburgh, Penn.; Wagner Malleable Products Co., Decatur, Ill.; J. R. Richards Co., Carnegie, Penn.; Kondu Mfg. Co., Ltd., Preston, Ont.



Switchgear at Lower Price Levels

METAL-CLAD SWITCHGEAR

reduces cost about half for switching centers

When a hospital recently undertook a modernization and expansion program, the enlightened use of this switchgear cut the cost of the switching center in half.

The 6-bay unit was installed to provide preferred and emergency sources of 12,000-volt power (with automatic throwover and return), and metering, plus switching and protection of the outgoing feeders to the load centers in each of two buildings. Secondary circuits are 220-volt 3-phase power, and 120/240 lighting.

The program also involved changing the supply voltage from 4 KV to 12 KV for greater over-all economy.

Scores of installations in a wide variety of industrial plants, public and commercial buildings have demonstrated beyond question that S&C reliability and performance cannot be surpassed . . . and you pay substantially less.

●

If you are planning a new installation, or have the job of modernizing an old one, don't let specifications leave the drawing board without first finding out how S&C Metal-clad Switchgear can save you money.

Nearly always it affords the lowest cost way to a thoroughly reliable switching center or service entrance unit. Write for full information today.

S&C ELECTRIC COMPANY

Formerly Schweitzer & Conrad, Inc.

4433 Ravenswood Ave., Chicago 40, Ill.

In Canada: Powerlite Devices, Ltd., Toronto

SPECIALISTS IN HIGH-VOLTAGE CIRCUIT INTERRUPTION

S&C Electric Company
4433 Ravenswood Ave., Chicago 40, Illinois

Please send me your new booklet on S&C Metalclad Switchgear. No obligation on my part, of course.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

WHAT *Life-Line* REALLY DELIVERS IS MORE SERVICE . . . LESS SERVICING

What *Life-Line* really delivers is

...more service
...less servicing

"We can't afford equipment breakdowns. We manufacture ice cream making machinery and operate franchise stores throughout the country. Store operators know very little about maintenance. We *must* select equipment that assures trouble-free performance with minimum maintenance. That's what Life-Lines give us. That's why we standardize on them."

The above statement by the chief engineer of an eastern manufacturing plant tells the Life-Line story best. Summed up it means more service, less servicing, with Life-Lines.

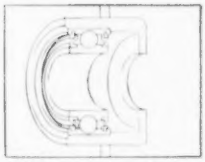
Take the Life-Linestarter, for example. Contacts last longer because exclusive "De-ion®" arc extinction snuffs out arcs fast . . . reduces contact pitting. Simple seesaw balance of clapper prevents accidental opening; kickout spring prevents accidental closing. Compare with any other starter and see why Life-Linestarters offer *more service with less servicing.*

The Life-Line motor's advance design completely eliminates periodic lubrication. Pre-lubricated factory-sealed ball bearings need no greasing attention. Further, steel construction cuts breakage from rough usage. Superior insulation and winding techniques lengthen electrical life. On-the-job reports of a half million Life-Lines show why you get more service with less servicing.

It costs no more to get Life-Line performance. Ask your Westinghouse representative for details or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-21684-A

YOU CAN BE SURE...IF IT'S
Westinghouse



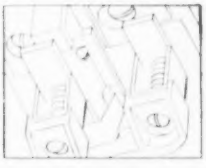
MOTOR

Needs no lubrication. Pre-lubricated factory-sealed bearings eliminate troubles due to under or overlubrication, dust and dirt.

Cuts winding burnouts. Pear-shaped slot design eliminates pockets. No corner voids remain to collect dirt, moisture.

STARTER

Never Jams. No sliding surfaces to wear—no sticking—no jamming—nothing to wear or replace.



Never needs filing. Silver-to-silver contacts eliminate filing. Discolored silver maintains high conductivity.

Maintenance Crews Won't Wait!

When conditions demand changes in buildings or machine layout, maintenance crews won't take the time to keep portable cords in the clear. Portable cords must be able to take all kinds of abuse and still operate dependably day in and day out. Portable maintenance equipment — drills, lamps, welders, etc. — depend on their continued operation.

To get your production lines in operation and keep them that way, give your skilled mechanics and maintenance crews a reliable portable cord. That means TIREX. These cords have a tough, *selenium-neoprene* armor that is *cured in lead*. This tough jacket gives balanced resistance to oil, grease, acids, flame, abrasion, snagging and tear.

To keep your maintenance tools in the very best condition, be sure that they are equipped with Simplex-TIREX Portable Cords. You can get them from your electrical distributor. Specify and be sure you get Simplex-TIREX Cords. They are marked for your protection.

Simplex WIRES & CABLES

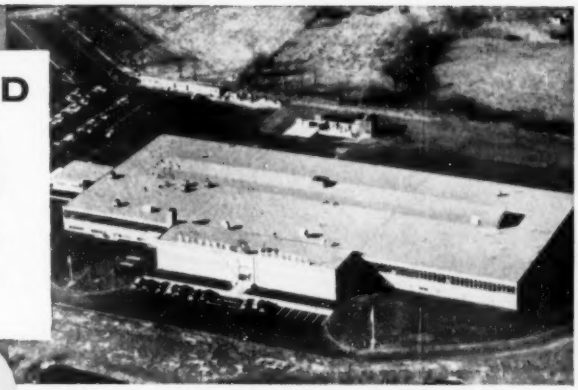
TIREX CORDS AND CABLES *are made only by the*

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Massachusetts

PRODUCTION SPEEDED AT SYLVANIA'S

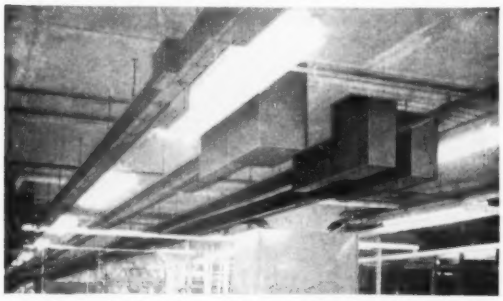
ELECTRONICS DIVISION NEW PLANT AT WOBURN, MASS.

with

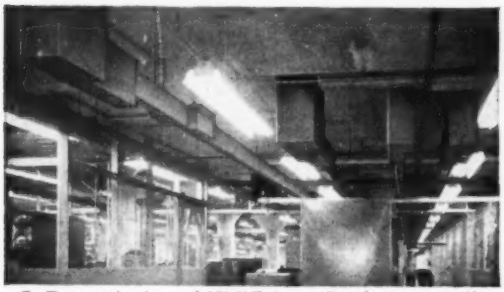


Aerial view of Sylvania's modern new electronics plant at Woburn, Mass.

Interior of Sylvania's Electronics Division new plant at Woburn, Mass. showing the effective use of (FA) Powerplugin and Hi-Efficiency Busduct to carry power from service entrance to all parts of the plant.



(FA) Powerplugin with a plugin outlet every foot of the way gives Sylvania the efficiency, flexibility and economy of operation so vital today.



(FA) Powerplugin and Hi-Efficiency Busduct are available in the following capacities:

(FA) Powerplugin — 250 to 1,000 amperes, 600 volts AC or less, with Klampswitchfuz, (disconnect) Shutlbrak (operating) and Circuit breaker plugin devices for 200 amperes and less, 2, 3, and 4 conductor, solid neutral types.

(FA) Hi-Efficiency Busduct — 600 to 4,000 amperes, 600 volts single phase for welding service; three phase or three phase, four wire service for light and power.

Powerplugin and Hi-Efficiency BUSDUCT

SYLVANIA, like many other companies throughout the country, found that (FA) Busduct added greatly to the efficiency, economy, and flexibility of its operations.

That is why the company installed (FA) Powerplugin and Hi-Efficiency Busduct in its Electronics Division new plant at Woburn, Mass. and others.

(FA) Busduct enables the company to make quick changes in plant and structural layouts without disrupting production. It eliminates temporary connections and long lead-ins, cuts maintenance costs and affords big savings by reducing power loss and voltage drop to a minimum. Too, it is 100% salvageable.

Built in standard ten foot lengths, (FA) Busduct can be easily arranged to run horizontally at floor level or overhead, through tunnels, under the street or through walls or roof. Dust-resisting and raintite construction available for specific installations.

If, like Sylvania, you want an efficient, economical, and flexible system of power distribution for your plant, ask your nearest (FA) representative, listed in Sweet's to tell you about (FA) Busduct.

Frank Adam Electric Co.

P. O. BOX 357
ST. LOUIS 3, MISSOURI

Makers of: BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

GET ON THE BEAM

For building lighting business

enter the lighting competition for electrical contractors...

... with one or more of the following types of lighting installations: Stores, Schools & Offices, Industrials, Residential, Floodlighting, Miscellaneous (hospitals, banks, lobbies, etc.)

- ★ $1050 in cash awards
- ★ Publication of winning entries
- ★ Free reprints of published articles for local sales promotion

The Competition closes on August 1st

Lighting Competition Chairman
ELECTRICAL CONSTRUCTION AND MAINTENANCE
330 West 42nd Street, New York 36, N. Y.

I'm not going to miss the boat. Send me the Rules Brochure and _____ Entry Forms.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

ELECTRICAL CONSTRUCTION AND MAINTENANCE

A McGRAW-HILL PUBLICATION
330 WEST 42nd STREET, NEW YORK 36, N. Y.

ANACONDA FORUM
for the Electrical Industry

REVISED ELECTRIC POWER EXPANSION PROGRAM

By: Walker L. Cisler, Chairman,
Electric Power Survey Committee,
Edison Electric Institute

FOLLOWING the outbreak of fighting in Korea in June 1950, the electric power systems of the United States promptly anticipated greatly increased power demands and revised the planned electric power expansion program sharply upwards. Between June of 1950 and April 1951, new generating projects totaling 20 million kilowatts were undertaken and orders for the equipment were placed with the manufacturers. As shown in the table, by April 1951 new projects totaling 32.1 million kilowatts were scheduled for operation, mostly before the end of 1954.

NEW POWER GOALS FOR 1956

Now, nearly two years later, the electric power expansion program has been enlarged further to total 47.7 million kilowatts planned for commercial operation in the years 1951 through 1956 and the programs for 1955 and 1956 are still incomplete. Thus within less than two years it has been necessary to plan and begin construction of projects having a generating capacity of 15.6 million kilowatts to keep pace with the electric power demands now forecast for 1954, 1955 and 1956. Approximately 4 million kilowatts of this is specifically for new requirements of the Atomic Energy Commission.

SHORTAGES HAMPER FULFILMENT

The progress which was made in 1951 and 1952 in fulfilling this program has been disappointing. In April 1951 about 16.0 million kilowatts of capacity was scheduled for operation in the two years, 1951 and 1952. Largely because of delays in obtaining materials for equipment manufacture and field construction, only 13.5 million kilowatts were completed in those two years.

The 2.5 million kilowatts which were not completed in 1952 have now been rescheduled into 1953, some projects, originally scheduled for 1953, have been rescheduled into 1954 and other projects, originally scheduled for 1954, have been rescheduled into 1955.

NEW PROGRAM CALLS FOR GREATER EFFORT

As a result of these changes, and the additions to the total program, 12.2 million kilowatts of new capacity are now scheduled for completion in 1953 and 10.6 million kilowatts in 1954. This is a truly stupendous program and because of the material shortages which have occurred during 1951 and 1952, there are grave doubts whether these goals can be met.

Great effort will be needed by all concerned to carry the program forward as closely as possible to schedule. Power requirements for 1953 and 1954 can be estimated with reasonable accuracy and capacity now planned is essential to provide satisfactory margins.

As we progress through the years, new requirements will develop, additional projects will be planned and efforts to complete them must continue unabated.

ELECTRIC POWER EXPANSION PROGRAM

Capacities Given as Millions of Kilowatts--Manufacturers Nameplate Rating

Scheduled for Operation	As of April 1, 1951	As of April 1, 1952	As of January 1953
1951	7.5	6.9*	6.9*
1952	8.5	8.9	6.6**
1953	10.7	11.9	12.2
1954	4.8	10.3	10.6
1955	0.6	4.0	9.2
1956	—	—	2.2
Total	**32.1**	**42.0**	**47.7**
New Capacity Planned Since April 1, 1951		9.9	15.6

*Actually completed during 1951. **Actually completed during 1952.

SERVICE NEEDED FOR 3,750,000 UNITS BY 1956

New ANACONDA Type N-SD Service Drop Cable can help speed installation . . . available in copper or aluminum

That's the mark the nation's builders will shoot for in the next 3 years (according to F. W. Dodge Co.). Power companies must match their efforts by providing prompt and adequate electric service.

Important consideration will be given to speed, ease and appearance of installation. These requirements are met by ANACONDA Type N-SD Cable—available with either neoprene or polyethylene insulation.

This cable handles easily . . . looks neat . . . is durable . . . resists weather. Two insulated conductors are wrapped around—and fully supported by—a bare neutral messenger. Conductors remain free of tension!

RIGHT TO THE RANGE. Where Type N-SD Cable is used to the weatherhead, contractors will find SILVALINE*, ANACONDA's URC Type SE Service Entrance Cable economical to install through meter and fuse box right to such appliances as ranges, water heaters. SILVALINE has special silvery finish that won't "blotch" when painted.

*Trademark

ANACONDA FORUM

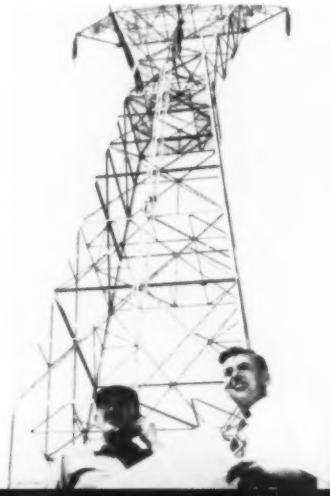
BUILDING OR EXPANDING YOUR ELECTRICAL PLANT?

In either planning a new electrical plant or correcting and improving an inadequate plant, it may save many a future headache to consider carefully these cable-selection pointers:

- An ample-size conductor always works for you.
- Choose your cable covering for its environment.
- Improve voltage regulation by using a larger conductor, reducing conductor spacing, dividing (or paralleling) circuits, improving power factor, and keeping high fluctuating load on separate feeders.
- Avoid loading feeders above 400 amperes, except in unusual cases. Above 400, cable becomes bulky, conduit expensive, difficult to install, and amount of load dropped on a fault is considerable.
- Conductor size should meet requirements for voltage regulation and current-carrying capacity for normal load and for motor circuits, short-circuit amperes.
- For greater reliability in insulated conductors, select Type RH, RH-RW, TW or Butyl-insulated instead of Types R or T.
- Aluminum conductors are satisfactory when properly installed.

"Bottlenecks" have no more place in power distribution than in shipping, accounting or administration departments. Best cure for electrical inadequacy is to install a well-designed, thoroughly engineered electrical system at the start . . . with cable that is right for the job.

BIG BOOM IN THE VALLEY. U.S. Steel builds its new Fairless Works in rural Bucks County, Penna. To meet the expanding needs for power—in new plants and homes—utilities in the area are adding new generating capacity and rushing new transmission and installation lines in the Delaware Valley.



INDUSTRIAL LIGHTING . . .

It's important to match cables to today's lighting needs

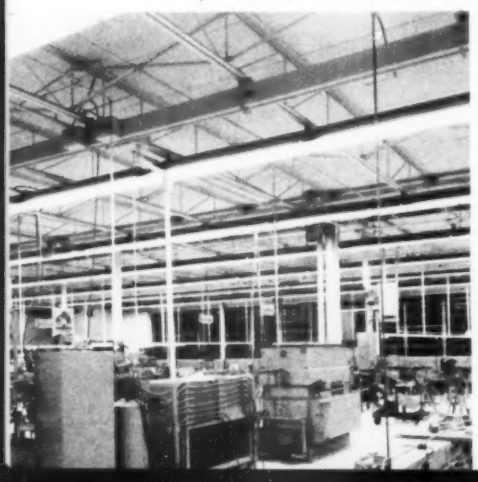
There are many reasons why today's lighting requirements are greater than in the past. There is a very definite relationship between higher intensity of illumination and greater and more efficient (or lower-overall cost) production. The demand for better lighting is continually increasing because people's ideas change with the continuous increase in efficiency of light production. You can readily see that today's industrial lighting, more often than not, requires fair-sized cable for feeders and branch circuits. Transformers located at convenient points make long runs less frequent and less necessary.

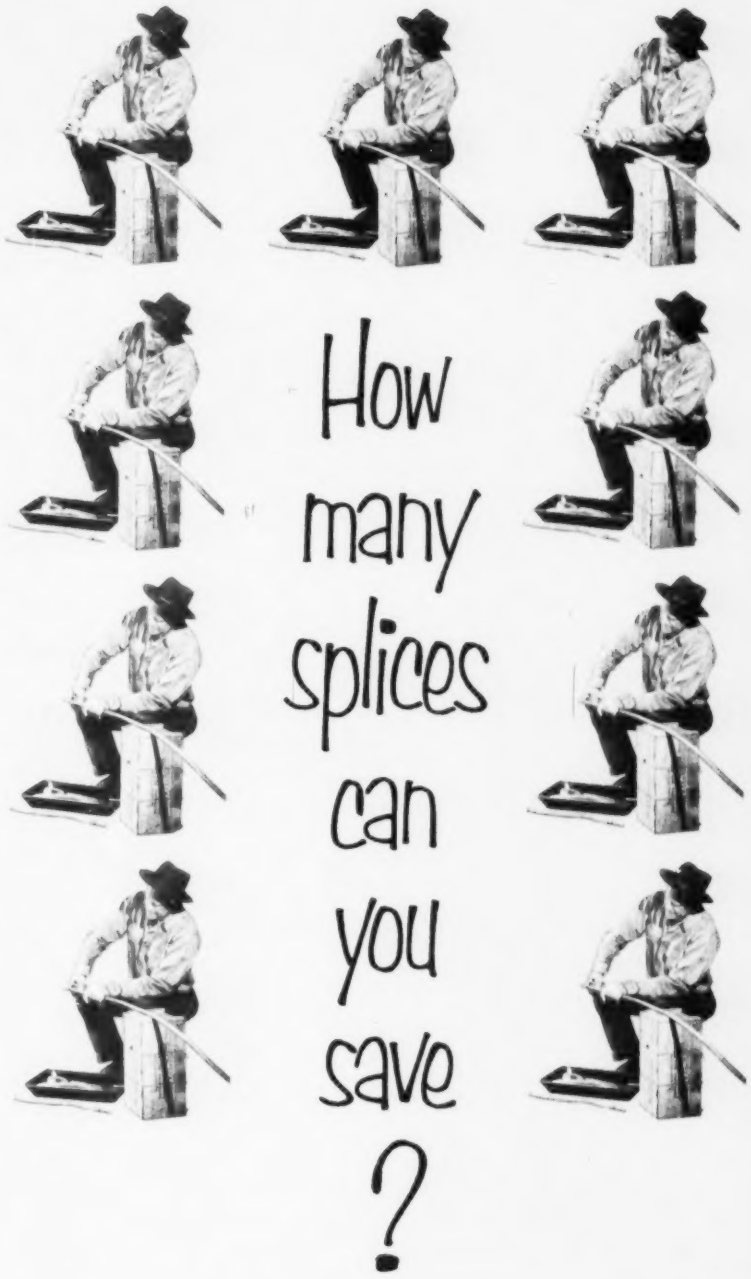
The principal conductors which may be used in industrial lighting are Types R, RH and RH-RW rubber and TW thermoplastic. Cables must be selected to satisfy two requirements: safe ampere load and permissible voltage drop. The smallest size—No. 14 Awg—should be used with care. Allowable current ratings, as given in the National Electric Code, are for safety only and may not satisfy voltage-drop requirements at all. This latter point cannot be stressed too often.

Good lighting is an important production tool. But, regardless of the number of units installed, a lighting system is no better than the circuits that serve it. Good lamp life and illumination efficiency depend upon operation at rated voltage—and this is only obtainable with circuit adequacy. And last but certainly not least, the design of the circuit should be made flexible enough to permit additions or alterations in the future. Some recent jobs have been designed and installed so that feeders and branch circuits are good for twice the present illumination.

THIS WORK AREA, 80 x 140 ft., is lighted by 136 fixtures to provide 50 foot-candles. Each fixture has two 75-watt, 96T-12 standard warm white fluorescent lamps.

—photo courtesy of Franklin Products Co.





All-Purpose DURASHEATH Cable is selected by industrial plants to simplify installations

The order of the day is expansion of power facilities. In industry this expansion means new power lines. Where these lines demand different types of cable as they shift from one location to another, time-consuming jointing becomes necessary. Jointing costs money . . . slows down cable installation.

Industrial plants have found a way out of these difficulties. They select DURASHEATH*, Anaconda's neoprene-jacketed power cable. This time-tested cable may be buried, strung overhead, and run in ducts *in one continuous run.* One cable type—not three—is needed.

DURASHEATH is available in all sizes, single or multi-conductor, copper or aluminum, from 600 to 15,000 volts. Use it for power cable in industrial plants, railroads, series or multiple street lighting, traffic control, and airport† lighting, residential primaries and secondaries, and for Type USE cable for underground service entrance.

*Reg. U.S. Pat. Off.

†when ordered to CAA Specifications L-824

SHORTS THAT MAKE SENSE

TAILOR-MADE. Do you know that you can purchase "packaged" power load centers and their components? You will find them easily installed and easily moved. They are well-engineered and basically right for your electrical plant. When you select the right cable to match them, you produce safe operation, prolong cable life and add to your service dependability.

WRONG CABLE. Here's a story with a moral: it pays to choose the right cable. An industrial plant routed a 1-conductor, 500 Mcm rubber and braid (Type R) conductor for a feeder run through 3 buildings, one a boiler house. Result: early failure where it ran through the boiler house. Insulation and braid became brittle, cracked and of no value. Ambient temperature was too high.

SAVE AND IMPROVE. Dry-type transformers have made great strides in their development for lighting. If you locate them at any convenient nearby point, you will save on copper size and at the same time improve voltage regulation.

START RIGHT. Cures cost money; prevention always has a lower price tag. To avoid trouble from electrical inadequacy, install a well-designed, thoroughly engineered system in the beginning. If you inherit an inadequate system, make specific check-ups at once to find the causes; then take proper steps to remedy the situation. Don't wait for real trouble. It never comes at the right time.

SYSTEM PLANNING. It's no joke to be caught with your plant down . . . through failure to anticipate future needs. Look ahead *now* to future needs. Remember that delivery and installation of new equipment take time . . . often up to two years. System planning prepares for potential increase in business.

SINGLE SOURCE. Many cable installations suffer from improper jointing and terminating. Poor design, inadequate materials, wrong methods, or all three are responsible. The cable and its accessories should be considered together. When the combination is furnished by one supplier, the responsibility for correct materials lies with him alone. It also saves time in placing orders.

LIGHTING CIRCUIT POINTERS. Spare lighting capacity is important. Plan carefully for future growth of the lighting system or increased illumination intensities. Consider fixtures to be used. Starting current on some types of units (high intensity mercury vapor) is higher than operating current. Use a minimum of No. 12 wire for all lighting circuits. Keep voltage drop within one percent.

in the years between now and 1956 . . .

which conductor shall it be for

America's electric power expansion?

COPPER

or

ALUMINUM

Some will choose copper . . .
some aluminum . . .
some both.

Whatever your final choice—it will always pay you to specify ANACONDA . . . because here is a *single* source of supply for:

copper and aluminum insulated cables
copper and aluminum service cables
copper, aluminum and copperweld bare and weatherproof
copper and ACSR transmission and distribution

Here, in the making of conductor, jacket, insulation and the entire cable, modern manufacturing techniques are backed by years of field engineering and construction experience. Metallurgical and development facilities are the most up-to-date.

FOR FURTHER INFORMATION about any product mentioned in the pages of this advertisement, see your Anaconda Representative . . . or write to *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

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TODAY'S HEADQUARTERS FOR WIRE AND CABLE

MAKERS OF building, barn, machine tool, control and communication wire • service and overhead distribution cables, bare and weatherproof including ACSR • portable cords and cables • power and bus-drop cables • mine, bridge, aerial, underground, duct, network and submarine cables • parkway, airport and street-lighting cables station, apparatus and vertical-riser cables • magnet wire • copper, aluminum and copperweld conductors • wire and cable accessories.

One Sure Way to Get MORE DEFENSE FOR LESS MONEY

How can we get more national defense for less money? The best answer yet given to this question appears in a little-noticed section of the new defense budget. That answer, with which this editorial is concerned, is to provide more equipment with which to step up munitions production in an emergency. Thus we can eliminate much of the need to stockpile finished munitions in advance.

The new defense budget provides an appropriation of $500 million, to be invested by the Secretary of Defense in specialized facilities required to produce munitions on a wartime scale, but not adapted to profitable operation by private industry in normal times. Facilities of this type are known as "stand-by capacity."

There is no strictly political controversy over the "stand-by capacity" program. It was originally suggested by Clay Bedford, Special Assistant to the Secretary of Defense during the Truman administration. It has since been reviewed and endorsed by the Eisenhower administration. Moreover, it involves little or no technical controversy. Civilian and military experts are well agreed that the only alternative to enormous expenditures for stockpiling military equipment is to provide enough facilities for producing it quickly in an emergency.

Here is the Key Idea

In his speech of May 19, introducing his defense budget to Congress and the nation, President Eisenhower stressed the value of such reserve capacity in these terms, ***"The more swiftly and smoothly we can mobilize, the less our dependence upon costly standing armies and navies."***

In accord with this idea, the $500 million requested for the present reserve capacity program would be invested in tools that require a long time to produce, and so present grave complications in an emergency unless they are ready in advance. Some such tools would be installed in new plants that are needed to eliminate potential bottlenecks in the defense production program. Others would be ordered to replace that part of the government's present machine-tool inventory which is made obsolete by changes in the design of defense products. By completely "tooling up" with the most modern equipment, the admin-

istration hopes to realize a production potential many times greater than could be achieved by spending the same amount of money on military end-products.

Examples of Savings

In the specialized field of defense production, adequate modern capacity is the key to both economy and speedy delivery in a pinch. Here are some striking examples from the recent report of the Advisory Committee on Production Equipment (Vance Committee) to the Director of Defense Mobilization:*

—In the case of certain ammunition components, the cost of new capacity can be recovered in only six weeks of full production.

—If $500 million worth of special tools needed to make aircraft are purchased in advance, aircraft production during the first two years of war will be increased about $18 billion. In other words, it costs 1/36 as much to acquire the tools in advance as to acquire the aircraft.

—In the case of a certain ordnance item, an expenditure equal to the cost of only 150 units of the item will provide the capacity to produce thousands and save three years' time in meeting mobilization requirements.

Moreover, reserve plants and equipment can be kept up-to-date at only a small fraction of the cost required to maintain an up-to-date reserve of military end-products. The cost of replacing 5,000 obsolete tanks is at least $1 billion. The cost of new tools for a tank plant would be less than 10% of that amount.

*This Committee, headed by Mr. Harold Vance, President of the Studebaker Corporation, included Clay Bedford, then President of Chase Aircraft, Manly Fleischman, former Defense Production Administrator, and several retired military leaders with wide experience in procurement.

Savings Will Multiply

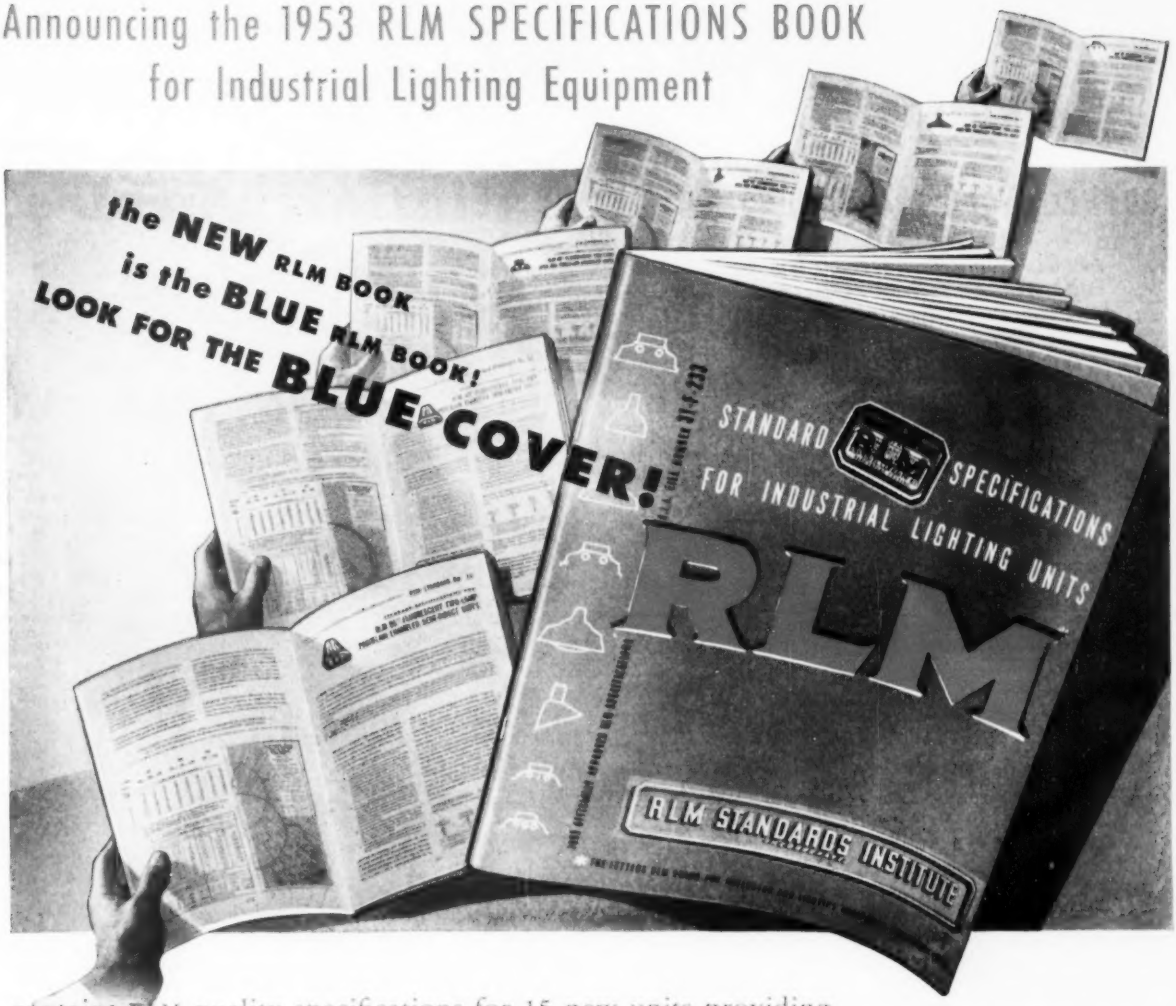
On the basis of facts like these, the Vance Committee recommended that the Defense Department spend $500 million to $800 million per year on specialized defense production facilities in order to provide substantial reserve capacity as soon as possible. It also recommended that expenditures for military end-products which get obsolete rapidly be held to a minimum. The Eisenhower administration has adopted this approach to the problem of munitions production in asking that $500 million be invested in reserve capacity.

The importance of this approach is much greater than is indicated by the amount of money to be spent on new tools, although this amount will go far toward assuring a healthy machine tool industry, adequate to meet emergency demands. ***What is really important is the great saving that can eventually be made in the cost of our defense program by a modern tooling program.*** If we are to maintain this program for a long period, and if we are to pay as we go, we must have a low-cost program. No other plan to reduce and control the cost of a garrison economy can compare with the new approach suggested in the Vance Report and now embodied in the new defense budget.

Congressmen will do well to scrutinize all military appropriations carefully. They have a chronic tendency to be too big. But there should be no penny-pinching on investments in capital equipment that will pay out in as short a time as six weeks in a war emergency. It would be tragic if this opportunity for real economy were lost in the controversy over other aspects of the defense program. ***The tooling program is a key part of the Eisenhower effort to cut defense costs. It should be promptly approved.***

McGraw-Hill Publishing Company, Inc.

Announcing the 1953 RLM SPECIFICATIONS BOOK for Industrial Lighting Equipment



contains RLM quality specifications for 15 new units providing
GREATER UPWARD LIGHT for even better industrial seeing conditions
plus IMPORTANT REVISIONS AND ADDITIONS to the other 68 RLM Specifications

Your copy of this newly-published reference book on industrial lighting equipment is ready now at no cost or obligation. Tens of thousands of architects, lighting engineers, electrical contractors, industrial executives and others have for 10 years relied on the RLM Specifications Book as an invaluable aid in measuring illumination, construction and performance standards, which are basic to lighting equipment efficiency, economy and ease of maintenance.

This new 1953 "blue-cover" edition is even more useful and valuable. It incorporates long-awaited specifications for 48", 72" and 96" RLM Semi-Direct Fluorescent Units. The new specifications cover 15 variations of this new "Upward Component" unit which directs from 20 to 30% of the light upward.

Altogether, this greatly-enlarged 1953 RLM Specifications Book has 52 pages, covering 83 different types and sizes of RLM-certified incandescent, fluorescent and mercury industrial lighting units. All specifications have been brought up-to-date in accordance with latest illuminating engineering developments.

Whether you buy, sell or specify industrial lighting equipment, you are invited to send for your FREE copy of the 1953 "blue-cover" edition of the RLM Specifications Book. Address request on your letterhead, please, to: RLM STANDARDS INSTITUTE, SUITE 819, 326 W. Madison Street, Chicago 6, Illinois.

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COMPLIANCE WITH SPECIFICATIONS APPROVED, INSPECTED AND LISTED BY ELECTRICAL TESTING LABORATORIES, INC.

RLM STANDARDS INSTITUTE INCORPORATED

The letters RLM stand for Reflector and Lighting Equipment Manufacturers

R251

Remember EDWARDS...

and forget your installation worries!

Edwards equipment is designed with the contractor in mind. Ease of installation saves valuable man hours. Precision engineering provides rugged, trouble-free operation with minimum of servicing and maintenance.

You build both profit and prestige when you install "Edwards" quality equipment.

ADAPTABEL

The most popular heavy duty bell . . . has clear tone with exceptional carrying power. By actual test the Edwards Adaptabel is 140% louder than any other bell of equivalent size. Listed by Underwriters' Laboratories. Available in 4", 6", 10" sizes.

size	Loudness Factor decibels*	loudness units
4-inch	77	13,500
6 inch	83	21,400
10 inch	89	35,000

*at ten feet

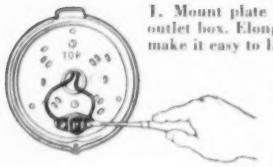
ADAPTAHORN

Where maximum loudness is required . . . especially over unusual noise conditions, the Edwards Adaptahorn never misses. Loud or muted this is one horn that keeps its adjustment . . . never changes once it's set. Listed by Underwriters' Laboratories.

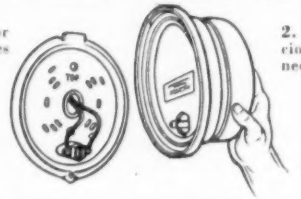
type	Loudness Factor decibels*	loudness units
flush	94	52,000
projector	91	40,000
grille	98	80,000

*at ten feet

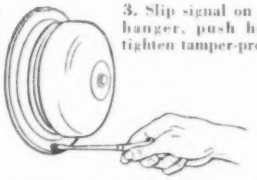
UNIVERSAL MOUNTING PLATE FITS BOTH ADAPTABEL AND ADAPTAHORN



1. Mount plate on wall or outlet box. Elongated holes make it easy to line up.

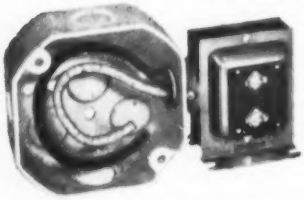


2. Pull wire through spacious center hole and connect to large binding posts.



3. Slip signal on to sturdy hanger, push home and tighten tamper-proof screw.

EASI-MOUNT TRANSFORMER



For easy and speedy installation the Easi-Mount is unsurpassed. Mounts to any half-inch knockout with expandable nipple, adjustable by an outside set-screw. Can also be surface mounted. For door bells and chimes.

LOW VOLTAGE PUSH BUTTON

On quality and performance, Edwards famous "No. 620" has rightfully earned its distinction of being the world's most widely used flush push button. Has positive, self-cleaning contacts. Mounts in 7/8" hole with spring clips.

ALL PURPOSE CONTACTOR

ALL PURPOSE to make or open contact on doors, windows, transoms, safes, burglar alarm systems, as foot push, automatic machinery, etc., operates from pressure in any direction. Made of brass, fits 3/4" hole. For low voltage.

ASK YOUR WHOLESALER— OR WRITE FOR NEW ILLUSTRATED STAPLES BULLETIN

EDWARDS *Company, Inc.*

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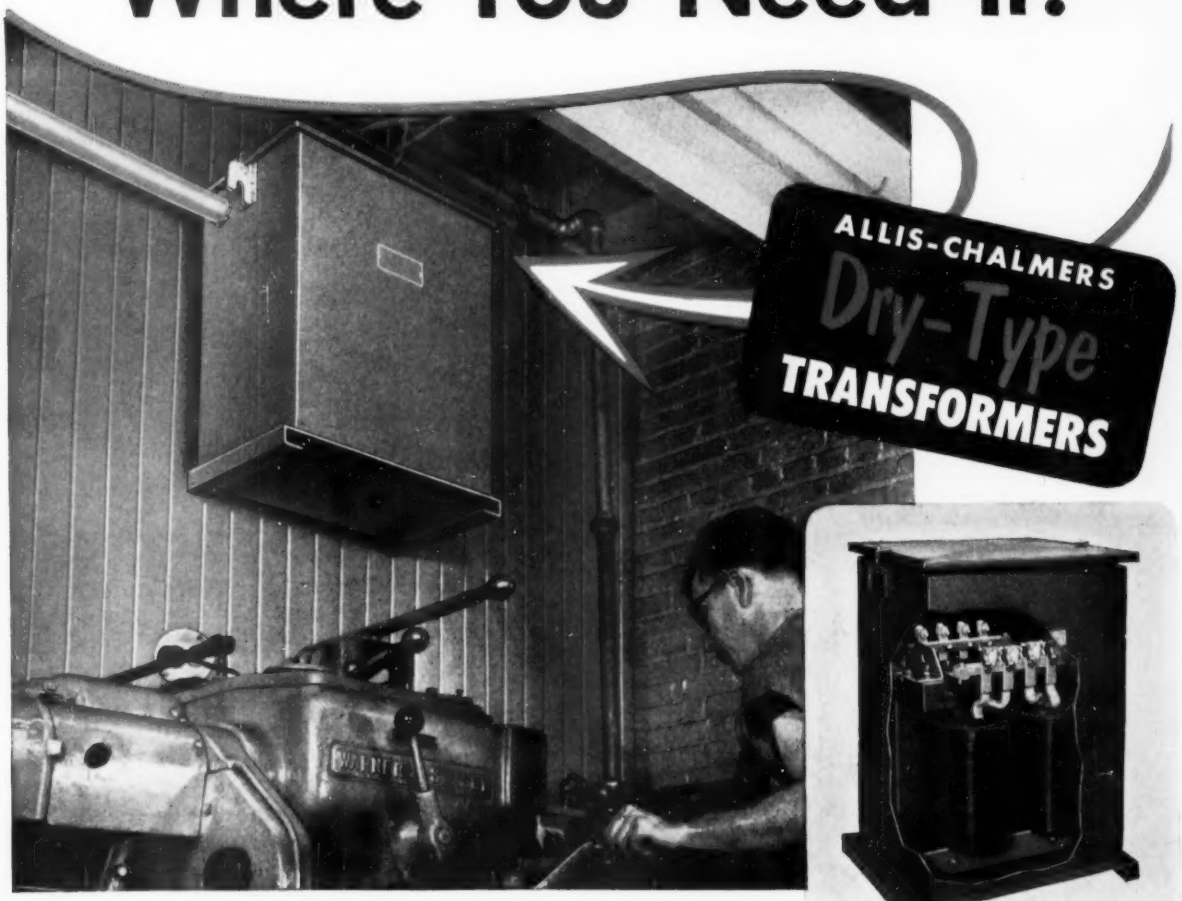
PUT POWER Where You Need It!



HERE'S THE WAY to assure rated voltage for motors and other equipment. Install Allis-Chalmers dry-type transformers close to the load to provide full voltage for efficient motor operation, flicker-free lights, and full heating of thermal equipment.

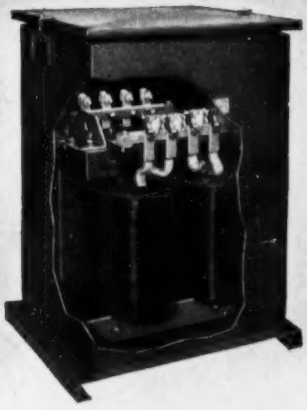
You can mount them anywhere, on posts, beams or walls, in a small amount of space, or right on the machine itself. You don't need vaults or expensive enclosures.

Installation is easy because junction boxes are eliminated. Knockouts are provided for connecting conduits directly to the transformer case. System cables are connected to the transformer terminals in compartments.

Maintenance is easy, too. You install Allis-Chalmers transformers and forget them except for periodic inspections. There are no insulating liquids to maintain; no gauges or gaskets to fuss with.

Get more information from your Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3980



IT'S ENDURANCE BUILT

Core and coil assembly is impregnated to guard against moisture and dirt. All-welded, modern looking case protects the internal assembly. Case is Spra-Bonderized to protect it against corrosion. Three coats of baked-on alkyd resinous paint furnish additional protection.

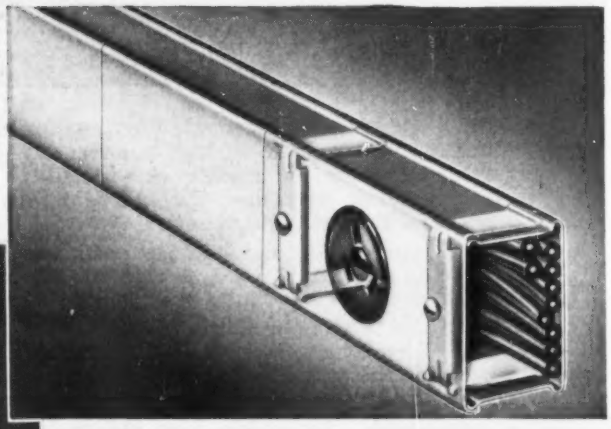
Ratings 167 kva and smaller (single phase); 300 kva and smaller (three phase); 600 volts and below.

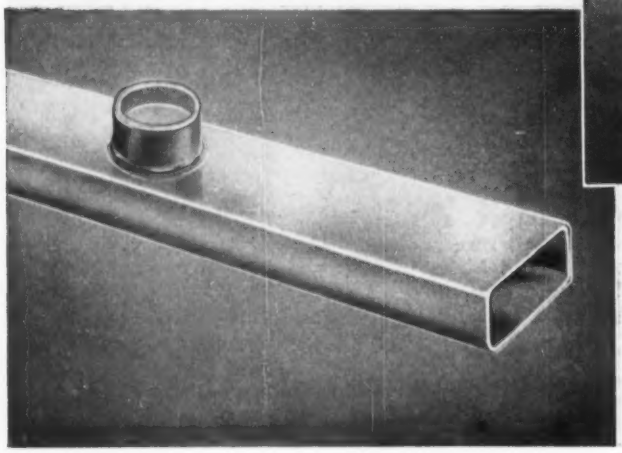
ALLIS-CHALMERS

NATIONAL ELECTRIC STEEL

NEPCODUCT PROVIDES OUTLETS ON THE FLOOR SURFACE for power, light, telephone and intercommunication systems. Hospital Service can now provide floor outlets wherever they are needed with Nepcoduct's safe, attractive Service Fittings.

SURFACEDUCT is an all-purpose surface raceway especially suitable for wiring modernization . . . flexible lighting layouts . . . wiring extensions, additions and relocations. Two-piece base and capping with the "lay-in" method for conductors. No wire fishing. Attach base, lay in the wires, snap on the capping. For loads up to 60 amperes. Quick, flexible, easy to install, economical, 100% salvable.





NEPCODUCT provides convenient, flexible, *permanent* electric wiring under the floor. Fits any type of floor construction—ideal for wiring modernization as well as new construction. Brings electric power to the *floor surface*, outlets already threaded, ready to use. *Simple . . . Safe . . . Speedy.*

RACEWAYS

QUICK ELECTRICAL MODERNIZATION

IN OFFICES OF HOSPITAL SERVICE ASSOCIATION OF PITTSBURGH

Electrical Contractor: Frame Electric Co.

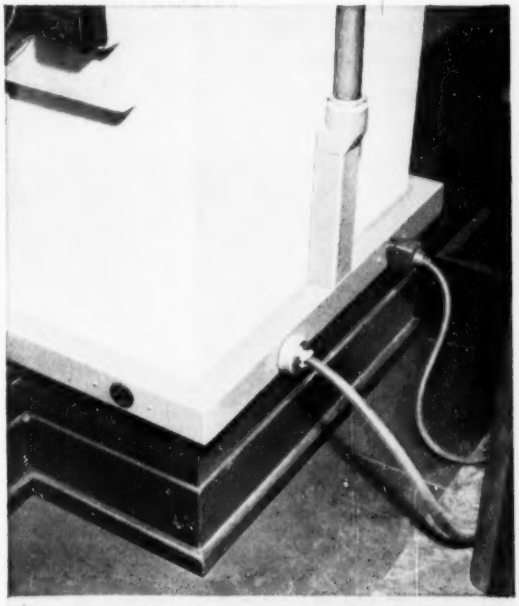
BLUE CROSS BLUE SHIELD

Electrical modernization was quickly, easily, *neatly* accomplished with National Electric Steel Raceways at the new headquarters of the Hospital Service Association of Pittsburgh. Approximately 2000 feet of Nepcoduct, installed in accordance with desk layout plans, provides completely flexible underfloor wiring. Partitions and furniture can be moved at will . . . there's always an outlet at the new location. NE Surfaceduct was installed just above the baseboards all around the room. Easy to install—even on corners and angles—Surfaceduct provides easily accessible wire space for future service demands.

Whenever you have a rewiring problem in office or factory, insist on National Electric Steel Raceways. There's one for *every* electrical distribution need.

Listed by Underwriters' Laboratories, Inc.

Sold through leading electrical wholesalers.



SURFACEDUCT PROVIDES OUTLETS ALL AROUND THE ROOM . . . serves power to 20—or more—business machines . . . safely . . . conveniently.

EVERYTHING IN WIRING POINTS TO

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3 Plants • 7 Warehouses • 34 Sales Offices

Do you make this GLARING Error?

Litecontrol's Simple Solution

Providing adequate illumination is only part of any lighting problem. Harsh contrasts can easily turn a good installation into a glaring error.

In this office, LITECONTROL uses its fixture No. 3700 with Holophane low-brightness CONTROLENS to furnish the right light — yet eliminate all glare and sharp contrasts. Seeing is relaxed and easy at every point in the room.

Extremely shallow, this smart "surface troffer" fixture is only 4¼" deep. *Trigger Catches* open and close doors *at the snap of your fingers.* No screws or adjustments of any kind necessary.

On your next project, plan on having a better lighting installation, too, at *standard* fixture costs — call in your local LITECONTROL man.

LITECONTROL FIXTURE SERIES 3700

EASY TO OPEN, just a touch on the LITECONTROL Trigger Catches and doors spring conveniently open. No screws or adjustments necessary.

EASY TO CLOSE, simply push the LITECONTROL door shut. Trigger Catches snap and grip instantly, safely, dependably.

Installation: Honey-Krust Bakery, Lexington, Kentucky; **Area:** Office; **Engineer:** J. T. Cole, Lighting Engineer, Kentucky Utilities Company, Lexington, Kentucky; **Electrical Contractor:** Clyde Johns, Lexington, Kentucky; **Fixtures:** No. 3728 2-lamp surface fixture, using Holophane No. 9016 Low Brightness Lenses, and 96T12 slimline lamps. No. 3724 fixture, same, but with 48T12 slimline lamps; **Spacing:** 8'-6"; **Intensity:** Average 62 footcandles, after 2½ months of operation.

LITECONTROL *Fixtures*

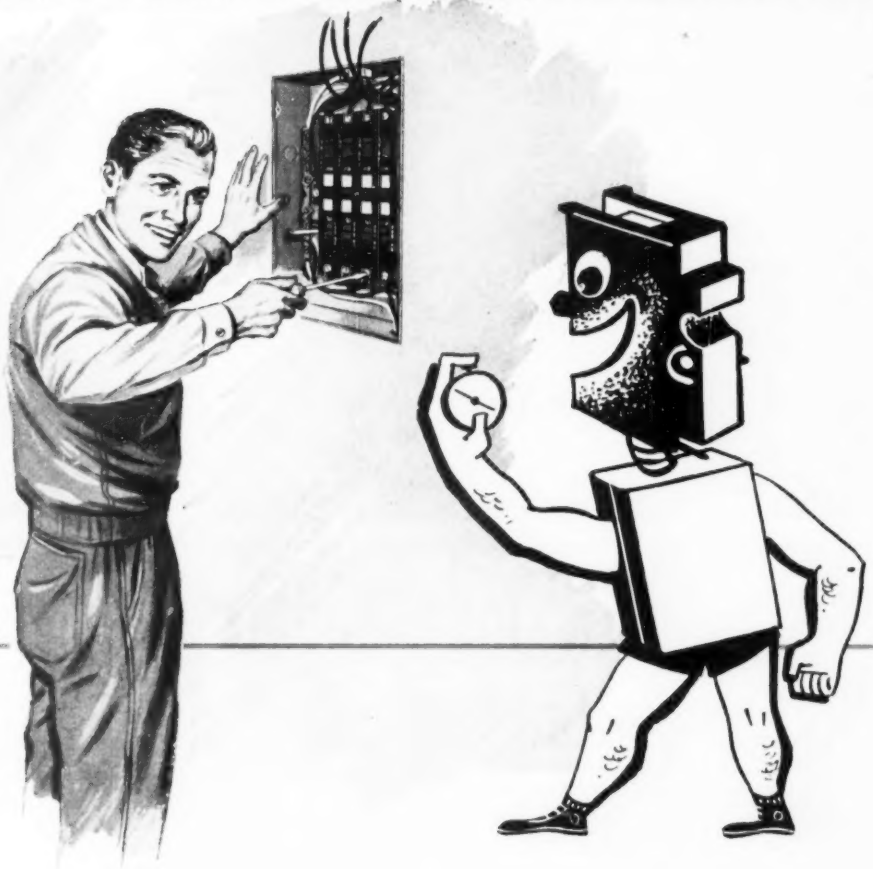
LITECONTROL CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

The contractor thought it was silly...

*till he proved to himself the **Stab-lok**® system costs least to install*



REPORT OF INTERVIEW WITH CONTRACTOR:

Q—We understand you compared the time to install different circuit breakers. What was the result?

A—It wasn't even close! Stab-lok was way out ahead. Stab-lok is so much quicker to install that it cuts labor costs way below other systems.

Q—What are the special features that speed up Stab-lok installation?

A—Well, first, Stab-lok plug-in type individual pole breakers provide the quickest method of securely connecting breakers to busses. Second, Stab-lok's solderless lugs give you today's simplest and fastest form of connection. Then, too, Stab-lok's lug type neutral saves the bother of wire looping... and removable main lugs, in the larger devices, save time when installing main conductors.

* * *

Besides these four features, there are still others that make Stab-lok least costly to install... easily removable interiors... large gutter space... conveniently located knockouts... simplest adjustment to plaster level on flush enclosures.

In addition, Stab-lok is the most modern, complete and flexible circuit protection system on the market. Write for full information, and order Stab-loks from your distributor. Federal Electric Products Company, 50 Paris Street, Newark 5, N. J.

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YEARS OF ELECTRICAL PROGRESS

G-E SHADOW-PROOF INSTRUMENTS OFFER A LONG SCALE FOR EASY READING, AND SMALL SIZE FOR ECONOMY OF SPACE.

G-E Switchboard Instruments Designed for Long-distance Reading, Sustained Accuracy

Behind the easily read face of the General Electric switchboard instrument is a story of sustained accuracy and space-saving design.

SUSTAINED ACCURACY—±1% of full scale is assured by building these long-scale instruments around a one-piece magnetic circuit. Since the circuit is thus made a solid mass, the air gap can never vary. Flux always flows evenly to give you accurate readings time after time.

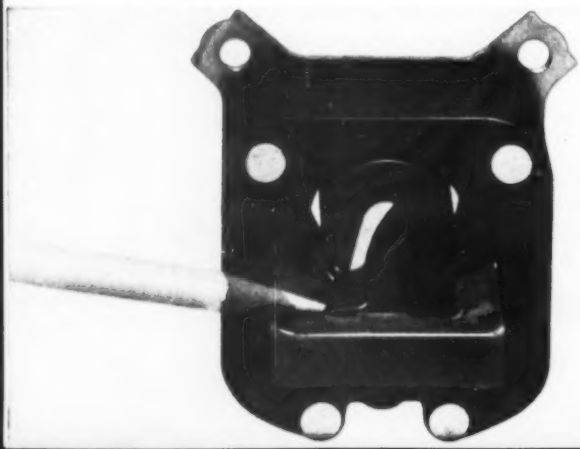
SPACE-SAVING DESIGN of G-E switchboard instruments makes it possible for you to save as much as 33⅓% of valuable switchboard space. A long-scale face only 4¼ inches across is attained because the instrument is designed to operate throughout a 250° arc.

FOR FURTHER INFORMATION, contact your nearest G-E Apparatus Sales representative, or write for bulletin GEC-218 to Section 602-257, General Electric Company, Schenectady 5, New York.

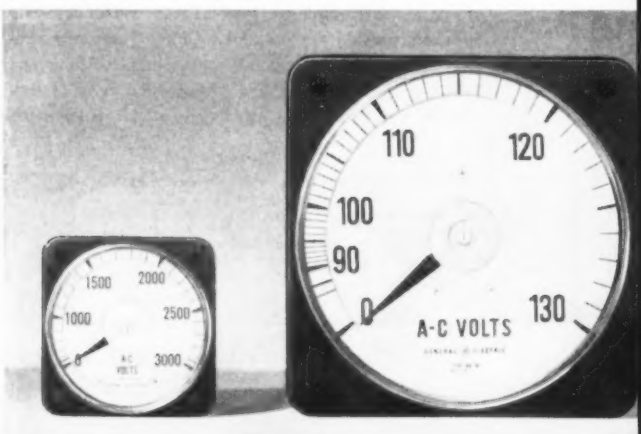
You can put your confidence in—

GENERAL ELECTRIC

ONE-PIECE CONSTRUCTION of the magnetic circuit provides a permanent air gap. Thus, flux density remains uniform, making for readings which are consistently accurate.



TWO SIZES AVAILABLE—4¼-inch and 8¾-inch. The large-size switchboard instrument is designed for those applications where readings must be taken at extra-long distances.



The DUTCH BRAND Insulating Foursome

1

DUTCH BRAND Friction Tape

DUTCH BRAND Friction Tape is well known for its dependability. It does not fray . . . has the necessary strength for good workmanship . . . the correct adhesion makes firmly held joints . . . removes from the roll easily and it has long life on the job. 2000 volts for single thickness. It is the type tape that is dependable and easy to work with. Be sure to get this top quality by asking for DUTCH BRAND.

2

DUTCH BRAND Plastic Tape

DUTCH BRAND Plastic Tape has proved a favorite because of its excellent performance. By actual test and use it has excelled in the plastic tape field. It is super thin, with ample strength and 150% stretch. It resists weather, oils, acids and corrosive chemicals. It is available in regular .007" thickness or heavy duty .010" thickness for winding heavy cables, heavy electrical harness or for use with power driven tape machines. Dielectric resistance averages 1000 volts per mil of thickness. The best test is to try DUTCH BRAND Plastic Tape... order it from your supplier today.

3

DUTCH BRAND Rubber Insulating Tape

Here is an old dependable of the electrical trade. "Tops" for years in electrical insulating work. It fuses instantly without heat and has the strength and stretch necessary for good joints. It resists up to 18,000 volts through a single thickness. It contains no corrosive chemicals. Its long life makes it dependable and workmen find it easy to work with. It costs no more to have the best . . . just specify DUTCH BRAND on every order.

4

"DB" Wire Connectors

"DB" Wire Connectors are the latest addition to the DUTCH BRAND line. They are made to careful specifications and high standards as has characterized DUTCH BRAND products for over forty years. They are made of high grade pheolic material and designed with long skirt for full insulating protection. They are weatherproof . . . vibration proof . . . resist pull-out-and are available in four standard sizes. Knurled design makes them easy to use. Order from your supplier along with your tape requirements.

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SORGEL
AIR-COOLED
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TRANSFORMERS

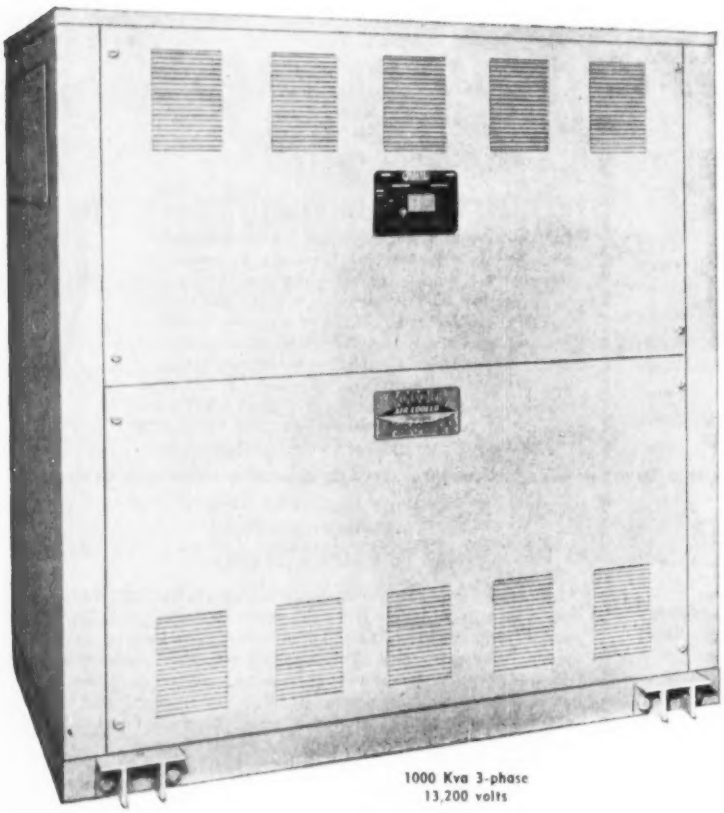
Accepted Quality

Complete Line

¼ to 1500 Kva single phase. 1 Kva to 3000 Kva 3-phase, 2-phase, and phase changing. All voltages up to 15,000 volts.

Also Substations, Special Transformers, Reactors

Accepted by Engineers, Contractors, U. S. Government, as Time-Tested and Top Quality



1000 Kva 3-phase
13,200 volts

¼ Kva
single phase
480/240 to
240/120 volts

100 Kva single phase

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Pioneers in the development and manufacturing of Air-Cooled Dry-Type Transformers — Over 35 years

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THE COMPLETE LINE OF TOP-FLIGHT CONDUIT . . .

AT YOUR SERVICE!

. . . for easier bending . . . for easier threading . . . for better installation . . . for more profits . . .

SPANG Conduit gives you these advantages because it is made of top-grade, quality-controlled steel, formed under exact heat conditions and inspected constantly during manufacture.

The care that goes into the manufacture and delivery of SPANG Conduit right up through the time it arrives at your distributor's makes SPANG a real quality-controlled product. When you ask for SPANG, you get a top-flight product . . . clean, workable, with years of dependable service built into it.

Ask any electrical contractor about SPANG Conduit—he'll tell you *why* SPANG is better!

CENLACO . . .

hot dipped and lacquered rigid steel conduit, easy to work and bend . . . exceptional corrosion-resisting properties. Couplings hot dipped zinc coated with electro-galvanized threads.

SPANG EMT . . .

lightweight steel tubing with the new SPANGLEAM electro-galvanized exterior finish for better appearance and the new interior coating of resinous lacquer compounded with Zirconium for easy wire pulling, assured grounding and corrosion resistance. Easy to cut, bend and install.

CENTRAL BLACK . . .

Black enamel rigid steel conduit, easy to work and bend . . . surfaces will not crack, chip or flake under the most severe bending strains. Couplings pickled before application.

CENTRAL WHITE . . .

Electro-galvanized rigid steel conduit, easy to work and bend . . . interior coating of black enamel assures a smooth surface, making an ideal raceway for easy wire pulling.

SPANG CONDUIT

SPANG-CHALFANT
Division of The National Supply Company
GENERAL SALES OFFICE
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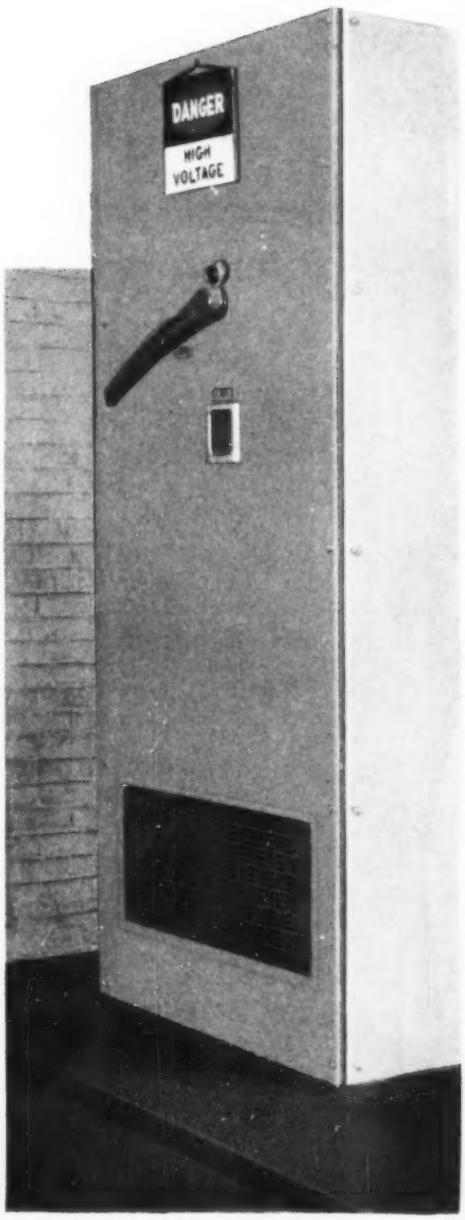
The best way to keep Power Distribution in step with Plant Expansion!



Rock Hill Printing and Finishing Company had a power problem that plagues many industries today. Their rapidly expanding plant was simply growing away from its power source. The resulting overextension and overloading of feeders created conditions that always hamper production: excessive line losses . . . poor voltage conditions . . . frequent service interruptions. But note how effectively a Westinghouse Power Center—serving as an additional distribution point—solved the problem . . .

"After the installation, we found voltage conditions improved as much as 10 percent . . . line losses reduced 5 percent . . . and unnecessary tripping out completely eliminated.

"Remarkably little time and engineering effort were required in making the installation. We found it almost as simple as plugging in an appliance. And we saved nearly 2000 feet of cable as a result of shorter, low-voltage runs."

This Westinghouse Dry-Type Power Center will enable this user to realize even further savings. The elimination of vaults, oil conditioning and testing, promises a saving in maintenance, virtually eliminates fire hazard, and provides greater safety for operating personnel. Westinghouse Power Centers offer these same advantages to you.

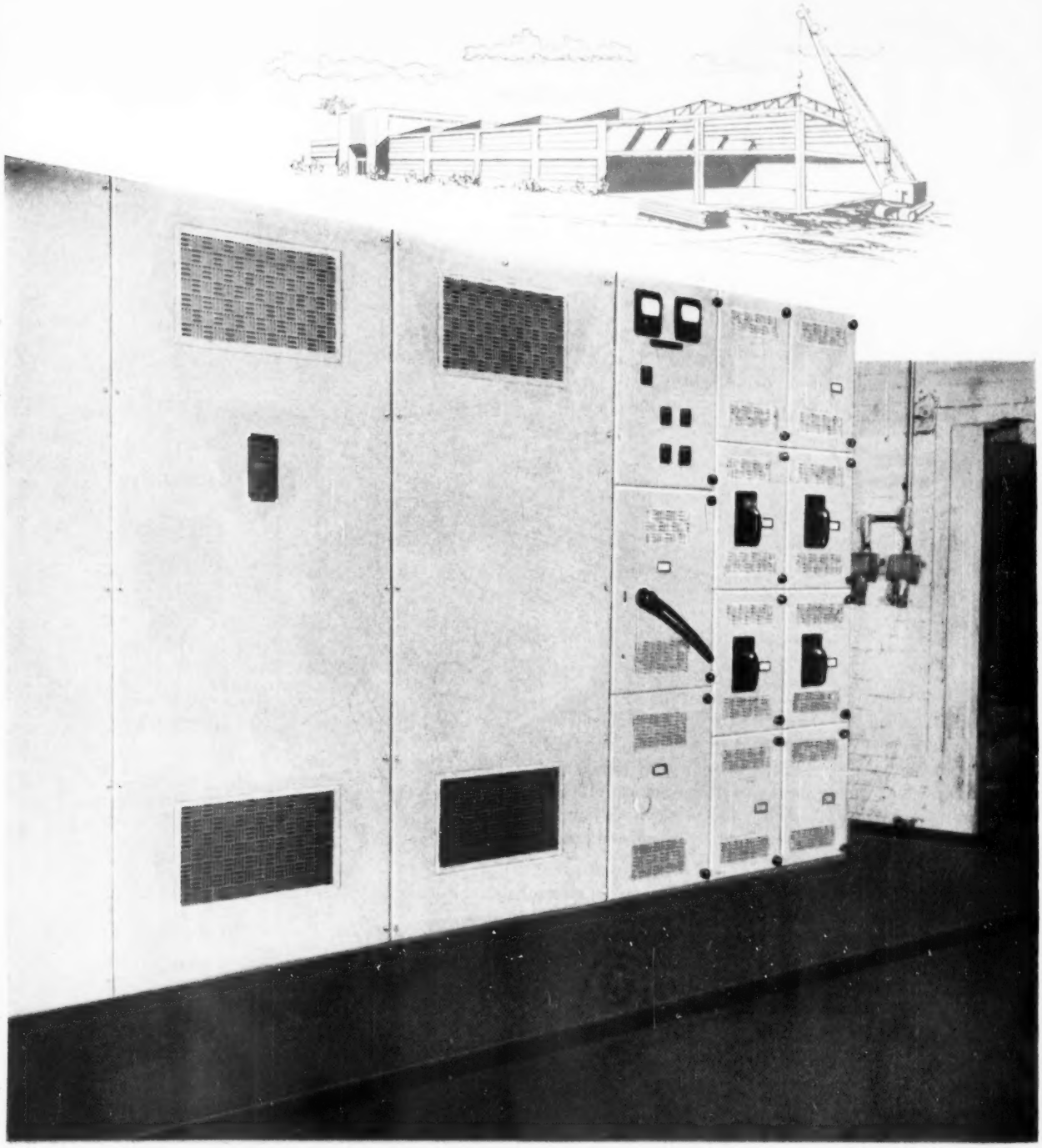
J-60777

GET THE COMPLETE STORY

Westinghouse Power Centers are the key to efficient power distribution. They offer better service continuity, greater flexibility, better regulation—all the things that contribute to power distribution economy. Most important, they provide the simplest, lowest cost way of attaining the power system that best meets your operating requirements.

Booklet B-4162 covers Westinghouse Power Centers in detail. Booklet B-4045 discusses various types of plant distribution systems wherein Power Centers offer maximum advantage. For your copies contact your Westinghouse Representative or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

YOU CAN BE SURE... IF IT'S
Westinghouse
POWER CENTERS



AT ROCK HILL PRINTING AND FINISHING COMPANY

Rock Hill, S.C. . . this Westinghouse Dry-Type Power Center is part of a distribution system as modern as the plant additions it serves. Located near the center of load it makes possible shorter secondaries, lower line losses, better regulation.

AUTH

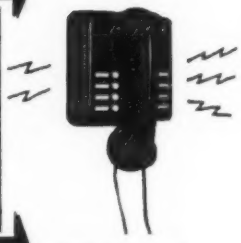
FOR

SIGNALS

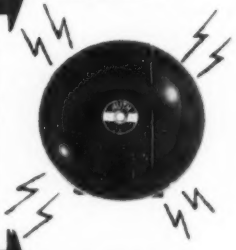
THAT

WINK!

SMILE!



BECKON!



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SHOUT!

Auth Electrical Signaling, Protective, and Communication Equipment is so varied in style, design, size, and function that there's scarcely a signaling or communication need that can't be met by an Auth product. Auth bells, buzzers, horns, push-buttons, chimes, telephones, or visual signals seldom fail to fit every application and every condition.

Complete signaling and communication systems for hospitals, schools, apartments, offices, stores, and banks are available. Protective equipment includes fire alarm, burglar alarm, and hold-up alarm systems. Marine bells, alarm panels, annunciators, and push buttons are other Auth specialties.

That's why the name AUTH is so readily acceptable — and why it will pay you to specify or recommend Auth products.

Have you a copy of the complete Auth catalog? If not, write for one now. Keep it handy as a ready reference.

MANUFACTURERS OF
Electrical Signaling, Communication and Protective Equipment for Housing, Hospitals, Schools, Offices, Ships, and Industry.

SINCE 1892
AUTH

COMPLETE SYSTEMS • ONE RESPONSIBILITY

AUTH ELECTRIC COMPANY, INC.

34-20 45th St., Long Island City 1, N.Y.

For top maintenance—depend on "U. S." Tape!

FRICTION, RUBBER and PLASTIC

SECURITY® FRICTION TAPE

For electrical and general purpose jobs. This is the strong, tacky tape that really grips and stays on. The fabric has unusually high tensile strength to handle tough jobs. Straight-tearing, non-ravelling. No pinholes to cause leaks. Rely on Security to stay on. Available also in specification grade—U.S. Holdtite®—exceeds A.S.T.M. specifications.

SECURITY RUBBER TAPE

For all general electrical work. This unvulcanized rubber splicing compound has the necessary physical properties: tensile strength, elongation, tackiness, plus the dielectric strength needed for durable splices. It is easy to handle and will fuse into a solid mass without heat or undue pressure. Available also in a specification grade—U.S. Holdtite—exceeds A.S.T.M. specifications.

ROYALASTIC PLASTIC TAPE

Does the work of both rubber and friction tape in many uses. This is the tape many maintenance men find best for making a thin splice and keeping wiring neat and uncluttered. Complete mechanical and electrical protection. High tensile strength and excellent resistance to abrasion and to water, oils, acids, alkalies and corrosive chemicals. Good stretch...clings tightly... strips cleanly.

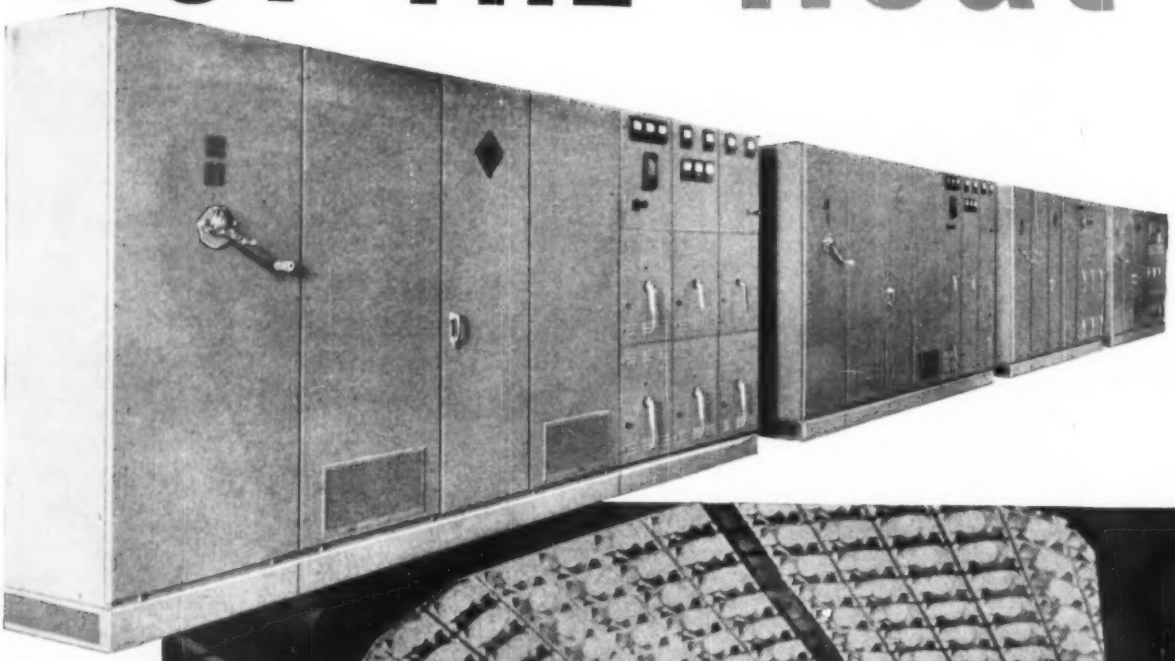
United States Rubber Company is a single source for industrial tape. Simplify your purchasing by using one line. See your distributor or contact any one of our 25 District Sales Offices.

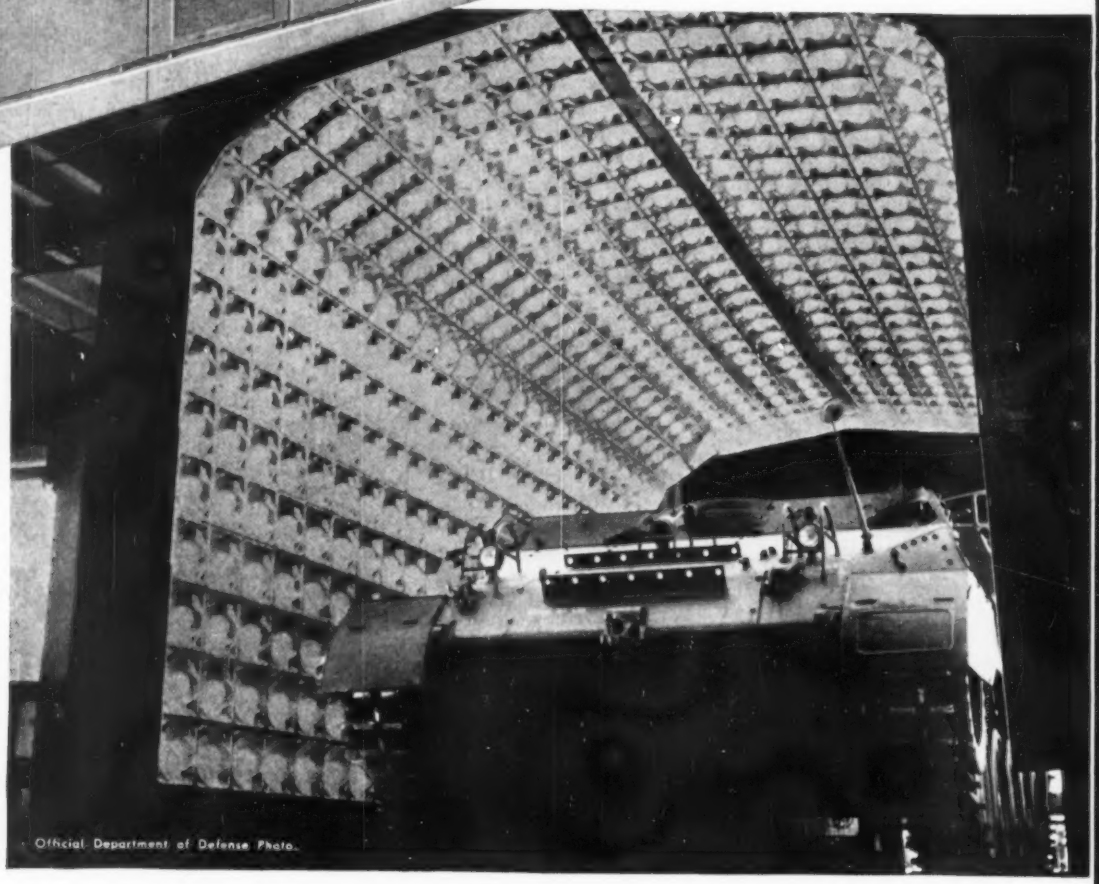
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

ALLIS-CHALMERS

PUT THE "Heat"





Official Department of Defense Photo

UNIT SUBSTATIONS

ON PRODUCTION!

YOU CAN INCREASE the production of your plant without adding production equipment or hiring more help . . . just eliminate undervoltage. Motors, lights, heating units—all electrical equipment gives top performance only when operated at full voltage.

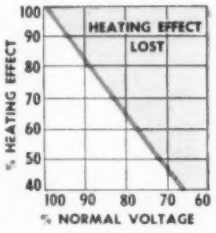
Paint baking or drying operations take longer when voltage drops. For example, a 10% drop reduces heating effect of infra-red lamps 19% . . . slows production. One paint drying operation required 63% more time when voltage dropped 10%.

A major cause of undervoltage is long, heavily loaded 480 volt feeders. Install Allis-Chalmers LCS Unit Substations at load centers and eliminate excessive line drop by shortening low voltage cables. Performance of all electrical equipment will improve . . . and personnel efficiency will increase because of better illumination from existing lighting fixtures.

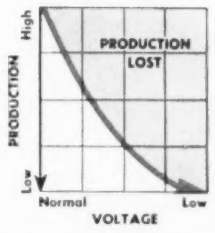
You can count on the cooperation of experienced Allis-Chalmers substation engineers in working out your distribution system. Allis-Chalmers LCS Load Center Unit Substations are neat, compact, easy to install and provide protection to personnel. Get in touch with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3372

ALLIS-CHALMERS LCS LOAD CENTER Unit Substations

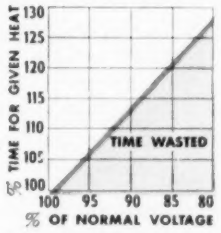
HOW UNDERVOLTAGE WASTES MANHOURS . . . CUTS PRODUCTION



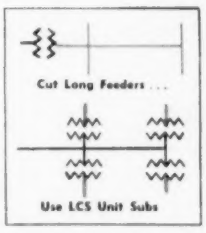
FULL OUTPUT from existing equipment demands full voltage. Heat output of infra-red lamps (used for baking paint on metal, drying coils of electrical apparatus and similar applications) drops with undervoltage. Output of resistance furnaces also drops off as the square of undervoltage.



PRODUCTION LOSSES RESULT from undervoltage. In one case a 10% drop in voltage cut the output of an infra-red drying oven from 1500 pounds per hour to 1275. Undervoltage means less work done each day . . . greater overhead for the work done, more manhours to be figured into every job.



TIME IS WASTED when undervoltage is distributed to infra-red bulbs and other heating devices. It takes longer to deliver the same amount of heat . . . longer to do a given job. In one plant, drying time for black painted sheet steel increased from 11 to 18 minutes by a 10% drop in voltage.



A MAJOR CAUSE OF UNDERVOLTAGE is voltage drop in secondary feeders. Long low voltage lines may prove inadequate as production schedules are stepped-up and new machines added. Install substations at load centers to cut feeder length, reduce voltage drop and increase production.

ALLIS-CHALMERS

LOAD FOR LOAD!

ROCKBESTOS A.V.C.®
(N.E.C. TYPE AVA)
COSTS LESS INSTALLED

For example, take a 430 ampere load at 40°C Ambient temperature. To use type RH cable, an 800 MCM is required but with Rockbestos A.V.C. (AVA), a size 500 MCM cable carries the same load and is 38% smaller.

Three 800 MCM type RH cables requires a 4" conduit, while with Rockbestos A.V.C. (AVA), a 3" conduit does the job. What's more, the quicker, easier handling of lighter-weight Rockbestos A.V.C. (AVA) reduces labor costs substantially.

Compared size for size, Rockbestos A.V.C. (AVA) helps you increase capacity simply by rewiring old conduits. No new larger conduit, fittings and accompanying labor are needed.

To get the full story on the practical advantages of Rockbestos A.V.C. (AVA) high ampere cable—write for the booklet "—Cut Cable Costs."

IT'S THE A.V.C. CONSTRUCTION THAT MAKES THE DIFFERENCE

Inner Felted Asbestos Wall

Varnished Cambric

Outer Felted Asbestos Wall

You can get life-long dependable service under severe operating conditions because these walls of impregnated felted asbestos permanently resist heat and moisture, mechanical damage and effectively seal the high dielectric varnished cambric tapes from deterioration.

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...Your best buy

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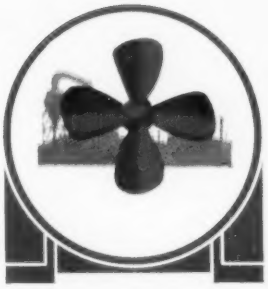
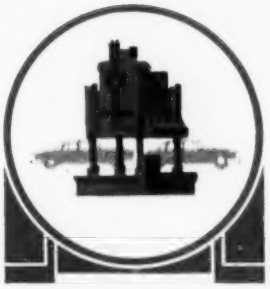
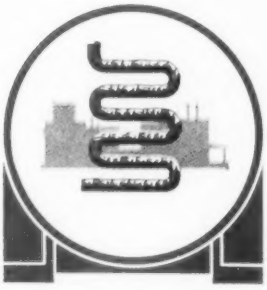


Ventilating



Metal Forming



Refrigeration

Oil Well Pumping

Electric Motors

for every industry

When you need electric motors . . . in any rating, or frame type . . . one or a thousand . . . *always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry.

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This complete AB-I Circuit Breaker line

solves more of your customers' problems— means more sales protection for you

Here's how to line up bigger circuit breaker sales—with the complete line of Westinghouse AB-I Circuit Breakers.

As shown above, there's an AB-I Breaker for *every* operating condition—indoors and outdoors, in wet and dusty locations, in explosive or corrosive vapors and dusts. Solving any application problem is merely a matter of selecting the right NEMA enclosure. Ends shopping around for "specials"—enables you to bid on jobs you couldn't handle formerly.

AB-I's solve many customer problems. They reduce downtime as much as 98%* compared with fused devices—eliminate dangerous fuse bridging, too. They save on maintenance—no replacement parts needed. They end unnecessary power outages with inverse-time-delay tripping action. And they protect workmen from live parts and costly accidents.

Certainly, AB-I Circuit Breakers can do a lot for your customers—and you! For complete information call your Westinghouse Representative or write for B-5456, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

**Name of company on request* J-30142

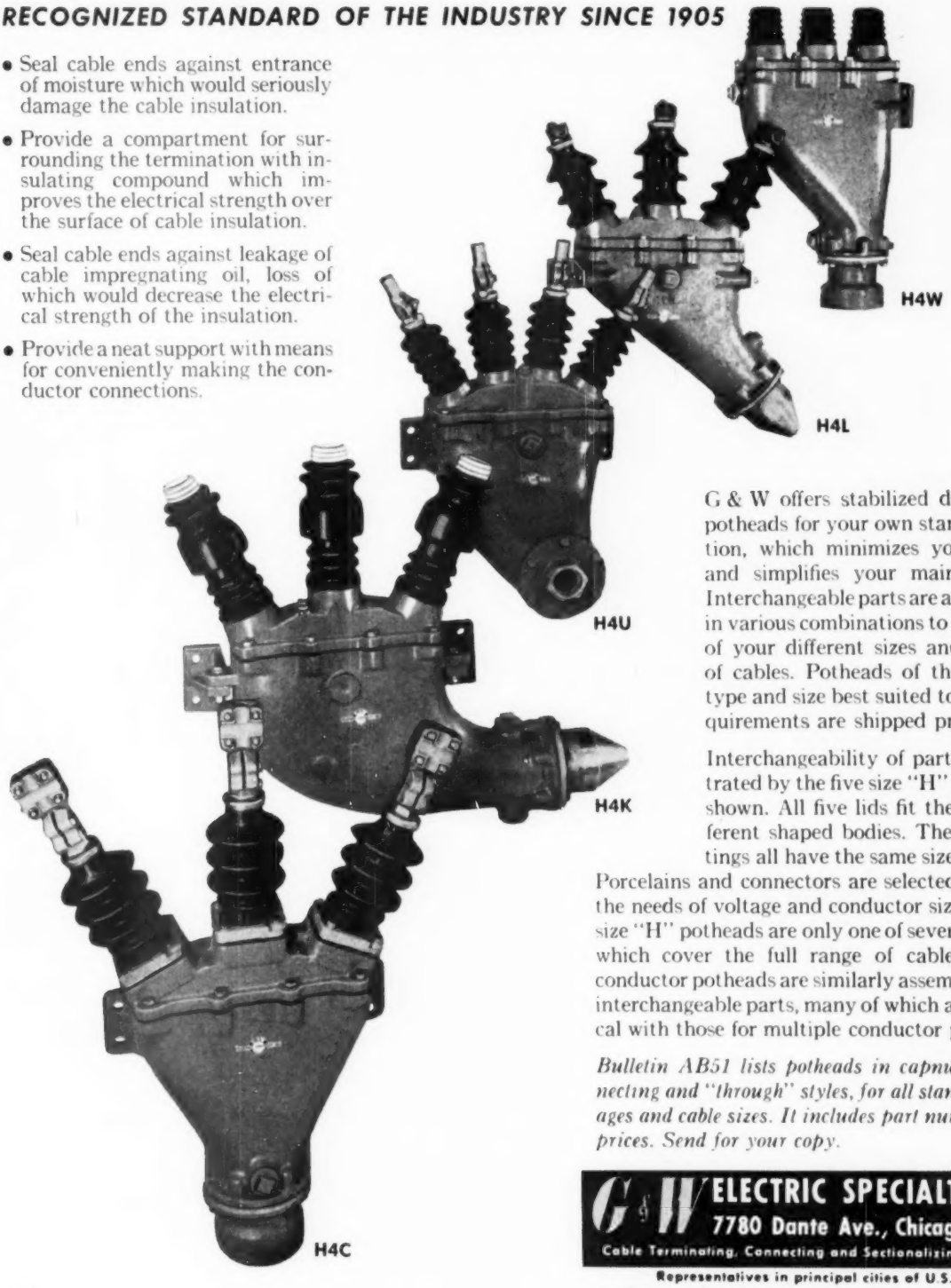
YOU CAN BE SURE... IF IT'S

Westinghouse

G & W Potheads

RECOGNIZED STANDARD OF THE INDUSTRY SINCE 1905

- Seal cable ends against entrance of moisture which would seriously damage the cable insulation.
- Provide a compartment for surrounding the termination with insulating compound which improves the electrical strength over the surface of cable insulation.
- Seal cable ends against leakage of cable impregnating oil, loss of which would decrease the electrical strength of the insulation.
- Provide a neat support with means for conveniently making the conductor connections.



G & W offers stabilized designs of potheads for your own standardization, which minimizes your stock and simplifies your maintenance. Interchangeable parts are assembled in various combinations to take care of your different sizes and ratings of cables. Potheads of the correct type and size best suited to your requirements are shipped promptly.

Interchangeability of parts is illustrated by the five size "H" potheads shown. All five lids fit the five different shaped bodies. The base fittings all have the same size 4 flange. Porcelains and connectors are selected to meet the needs of voltage and conductor sizes. These size "H" potheads are only one of several groups which cover the full range of cables. Single conductor potheads are similarly assembled with interchangeable parts, many of which are identical with those for multiple conductor potheads.

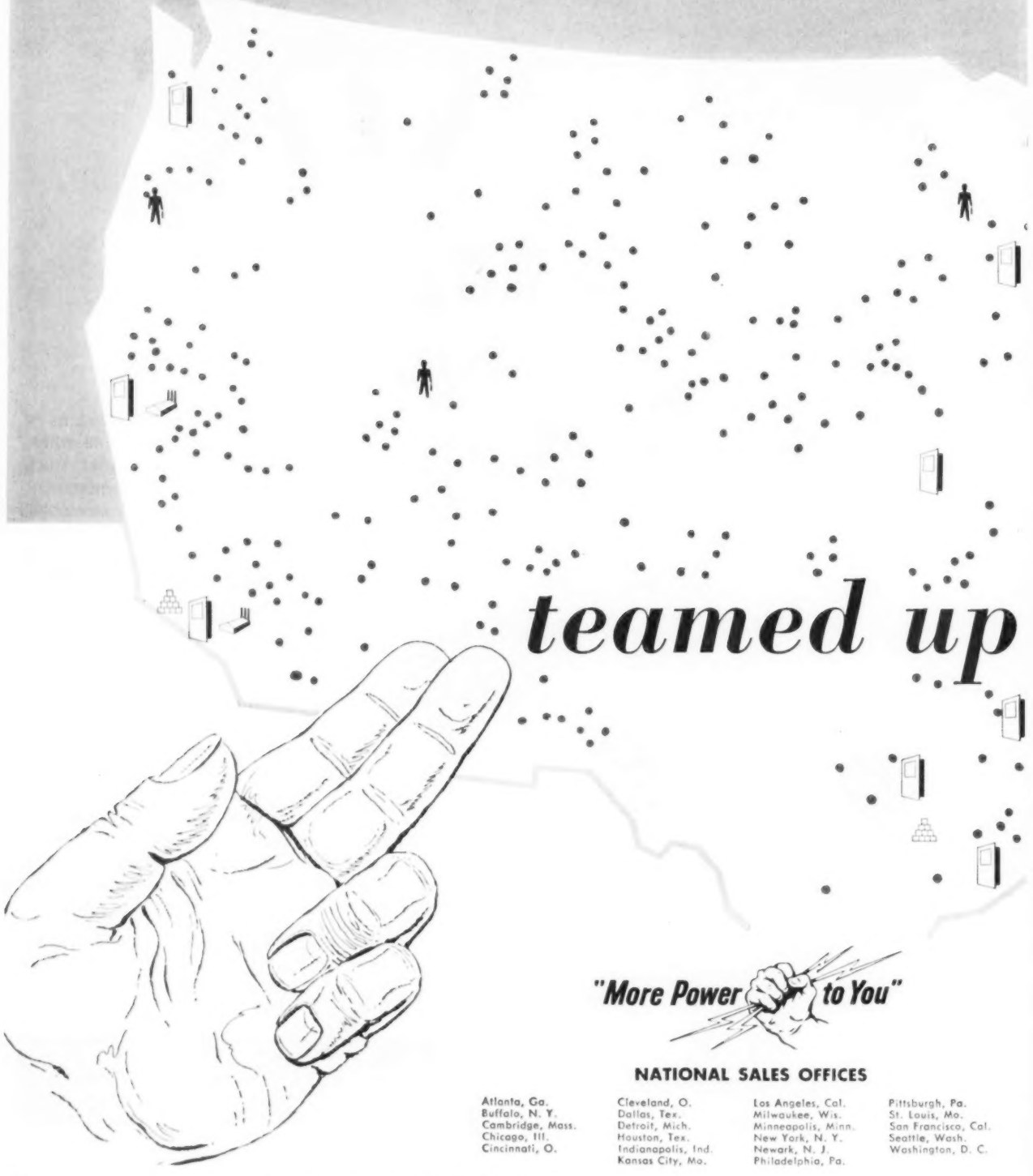
Bulletin AB51 lists potheads in capnut, disconnecting and "through" styles, for all standard voltages and cable sizes. It includes part numbers and prices. Send for your copy.

G & W ELECTRIC SPECIALTY CO.
7780 Dante Ave., Chicago 19, Ill.
Cable Terminating, Connecting and Sectionalizing Devices

Representatives in principal cities of U.S.A.
In Canada—Powerlite Devices Ltd., Toronto and Montreal

A534

General



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Cable

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- 6 Manufacturing Plants and Stocks

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One Completeness of Service
One Standard of Quality

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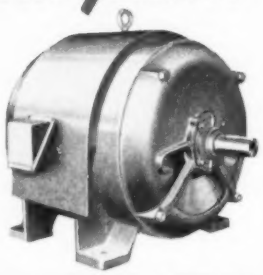
ELECTRIC MOTORS
...the choice of leaders in industry

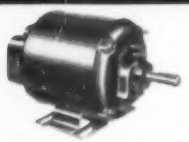
Wagner Quality Motors *for your product or your plant*

Whatever your motor requirements may be—single-phase or polyphase, 1/125 hp or 400 hp—Wagner can offer a standard motor that is entirely dependable in its specific application. The wide variety of motors shown here is typical of the many motors and motor modifications in the complete Wagner line.

At right is TYPE RP—open type polyphase squirrel-cage motor. It is drip-proof and suitable for all general purpose applications. 1/6 to 400 hp.



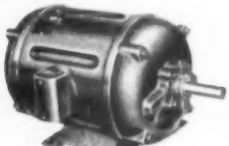
SINGLE-PHASE



TYPE RB—*Split-phase Induction. For easy starting applications with high starting current. 1/20 to ⅓ hp.*

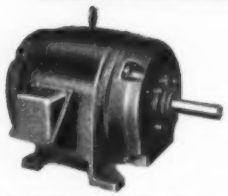
TYPE RK—*Capacitor-Start Induction. For general purpose applications requiring high starting torque—normal starting current. 1/6 to 5 hp.*

TYPE RG—*Repulsion-Induction. For high starting torque applications involving a very long starting period. 1 to 5 hp.*



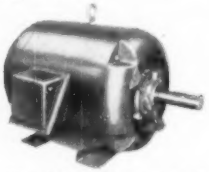
TYPE RA—*Repulsion-Start Induction. For general purpose applications with high starting torque—low starting current. ½ to 15 hp.*

POLYPHASE MOTORS



TYPE XP—*Splashproof. Protected against splashing or dripping liquids. ¾ to 200 hp.*

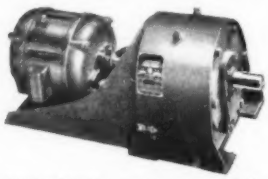
TYPE TP—*Totally-enclosed, non-ventilated. Fully protected. ¼ to 15 hp.*



TYPE CP—*Totally-Enclosed Fan-Cooled. Protected against dirt, chips, abrasives or fumes. Steel frame. 1 to 250 hp. Also in explosion proof type HP.*

TYPE EP—*Corrosion-resistant Totally-Enclosed Fan-Cooled. Cast iron frame. 2 to 250 hp. Also available in explosion proof type JP.*

TYPE RS-1—*Wound Rotor. Constant or adjustable varying speed. 1 to 250 hp. TYPE RS-2 for intermittent service. 2 to 200 hp.*



GEAR MOTORS—*Single-phase or Polyphase. Open or enclosed types. 1/20 to 50 hp.*

* * *

In addition to a complete line of motors, Wagner also furnishes Increment Type Motor and Starter Combinations, Jet Pump Motors and a complete line of Transformers: Dry-type, Distribution and Power. Wagner engineers welcome an opportunity to serve you. Consult the nearest of our 32 Branch offices, or write direct.

® Wagner Electric Corporation EST. 1891

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AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

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WIRES · CABLES · CORDS

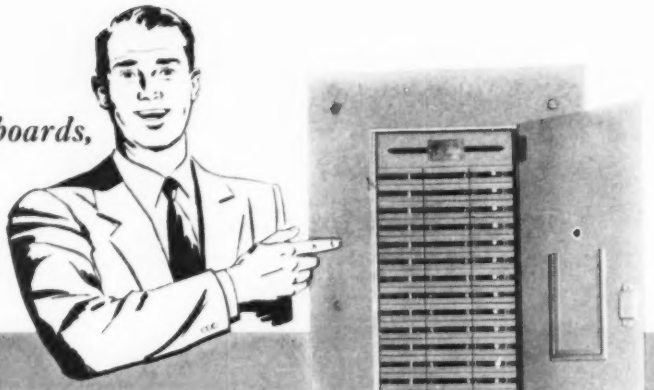
OVER 70 YEARS EXPERIENCE

From coast to coast for over two generations CRESCENT WIRE has been the choice of innumerable architects, engineers and electrical contractors for outstanding building jobs.

The CRESCENT wires in these buildings, which are still in use today, have given dependable service through the years.

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

Circuit breaker panelboards, of course, but...



"Westinghouse assembled panelboards

give my client better circuit protection"

● The surest protection you can get outside a Westinghouse Circuit Breaker is a Westinghouse Panelboard.

Here's why. First, Westinghouse Panelboards give basic circuit breaker protection—precisely, safely, lightning fast—with the Westinghouse principle of "De-ion®" arc extinction. Quick-make, quick-break, over-center toggle mechanism assures instant action in opening and closing circuits—team action that can't be beat.

Second, Westinghouse Panelboards are designed specifically to assure top performance of circuit breakers, electrically and mechanically.

Durability of construction and time and labor-saving extras have been engineered into every product. Design standards, manufacturing standards, assembly standards in the 13 Westinghouse Manufacturing and Repair Shops throughout the country are exacting, uniform—local service that gives you Westinghouse quality—everywhere. Another team action that can't be beat.

Call your Westinghouse Representative, or write for B-5260-A "Panelboard Planning", Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Penna.

J-93475

YOU CAN BE SURE... IF IT'S

Westinghouse

APPARATUS DISTRIBUTOR

"DE-ION" BREAKER PANELBOARDS

Washington Report

Continued high levels of business activity for balance of 1953, and well into 1954, are predicted by Commerce Secretary Weeks, although there is more and more talk in Congress and around Washington about a possible depression ahead. Construction is still setting records, capital equipment demand is strong, and auto production is at near-record level. Employment stays high, and personal income in the first four months of 1953 was estimated at $282-billion annually, up 7% above a year ago.

Anti-depression machinery is being planned, long-range, by Eisenhower. He is forming a new agency, the Advisory Board of Economic Growth & Stability, to recommend policy, see that it permeates government departments. First big project is a public works project, in case of a downturn.

A small depression was already in being in Washington at mid-year, brought on principally by release of over 25,000 government employees in the area since February. This has resulted in a housing surplus, cut retail sales sharply, created a general recession atmosphere which permeates all Civil Service staffed government offices, retail stores, real estate offices.

Defense Materials System regulations are now the Government's basic mechanism for support of Department of Defense and Atomic Energy Commission programs. NPA revoked its CMP Regulations 1, 3, 4 and 6 as of July 1, and CMP Regs. 5 and 7 expired automatically. CMP Reg. 2 was revoked May 1.

DMS-1 Regulation is a Designation of Scarce Materials, lists diamond grinding wheels, and five alloying elements—chromium, cobalt, molybdenum, columbian-tantalum and nickel. Materials withdrawn from previous NPA listing totaled 57. DMS-1 materials are subject to inventory provisions.

DMS-2 Regulation applies to construction for defense purposes only. Any defense construction being erected under CMP Reg. 6 priorities (ratings A, B, C, D and E) were revalidated under DMS-2, effective July 1.

Steel demand and supply is nearing a balance. Production in June dropped below 100% of capacity as some furnaces closed for repairs. Some buyers also adjusted tonnages downward as strike threats eased, others spread out deliveries over longer period.

Copper deliveries reached a new high in May for any month since January 1947—146,815 tons. Domestic production reached new records, and imports were coming in from Rhodesia and Belgion Congo at 30 cents and under per lb. Buyers generally held aloof from Chilean purchases, offered at 36½ cents a lb.

A new nickel purchase deal by U. S. Defense Materials Procurement Agency, made with International Nickel Co. of Canada, Ltd., involving 120-million lbs. to be delivered over 5-year period, will nearly complete its nickel stockpiling requirements, the Government announced recently. The contract also calls for purchase of 100 million lbs. of Canadian copper.

Excessive spending by Government agencies during June, last month of the Government fiscal year, would require explanation to Budget Bureau by August 1, according to Director Dodge in a mid-June warning. Any increases over level of recent months would be taken into account in making apportionments for the next (current) fiscal year.

Postal rate increases are being sought by Postmaster General Summerfield—4¢ first class, 3¢ postcards, 30% increase in 2nd and 3rd class mail. Boost of 35% on zoned parcel post rates was approved by ICC in June.

Electric power production continues at a record rate, is currently more than 15% ahead of rate a year ago.

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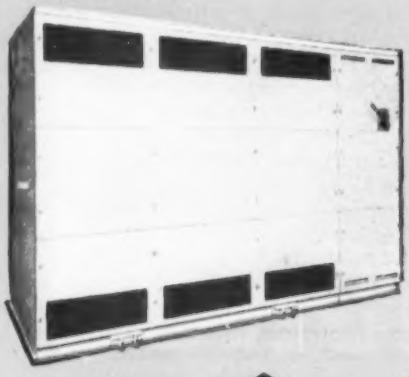

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Typical large Distribution Transformer Available in Standard Ratings of 167, 250, 333 and 500 Kva.

Higher distribution voltages give greater operating efficiency to electrical equipment through greatly improved voltage regulation. Industrial power rates are appreciably lower at higher distribution voltages.

Today's trend is toward consumers installing their own transformers to realize these sizeable savings and to achieve this improved voltage regulation.

Your local utility can advise you concerning the distribution voltage best suited to your needs.

In order to achieve the ultimate savings possible, specify Moloney Transformers. You will find, as many utilities already know, that Moloney Transformers afford the following features of prime importance:

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JULY . . . . at a Glance

Deadline—August 1

To be considered in the Lighting Competition for Electrical Contractors, all Competition Entry Folders *must* be postmarked not later than midnight, August 1. Competition Entry Folders with registration number can be issued to you only when we receive your official entry application. During the closing days of the Competition, entry applications will be processed at once and Competition Entry Folders returned by air mail. You may submit as many jobs as you wish in any of the six categories.

If you have not yet sent in your official entry applications there is still time, but a very short time, to get in under the deadline. If you are not submitting an entry yourself, be sure to check with other contractors in your area to make sure that outstanding lighting installations are being submitted and that your community is appropriately represented in the nation-wide competition.

Tools

We believe that the editorial feature this month on Modern Tools and Methods is the most complete and comprehensive study of electrical construction job mechanization ever attempted. Months ago Midwest Editor Gus Eckel was cleared of all other assignments to allow him to devote full time to this project. It took thousands of miles of travel and personal visits to dozens of construction jobs to gather photographs and data on actual operations.

We wish to express our cordial appreciation for the cooperation of tool and equipment manufacturers and electrical construction and repair firms who provided much of the background data and illustrative material and assisted us in all field operations.

Job mechanization is making unprecedented progress at this time and it is reasonable to assume that many current practices will eventually be outmoded by new and better tooling. So this round-up is not so much a record of achievement as it is a progress report. The opportunities for future development in job mechanization are still an open frontier.

Washington Scene

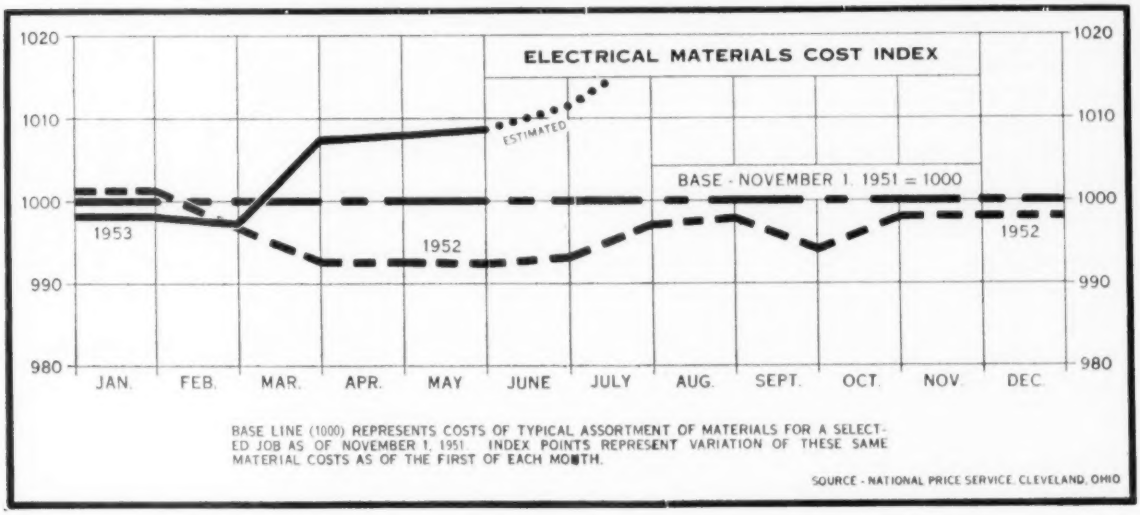
Quietly and with little fanfare the Eisenhower administration has been cutting down agencies and bureaus. Government-business relations are undergoing vast and basic changes. New personnel is bringing new policies into old-line departments. Some of these changes are ultimately going to affect electrical construction and it is Eastern Editor B. C. Cooper's task, with the cooperation of our Washington bureau, to watch and report their significance in his Washington Report (page 63).

On the Fire

Coming up in August is a report on the features of electrical design and installation at the huge Chevrolet assembly plant in Cleveland. Wired by Hatfield Electric and Fischbach-Moore, the project offers a wealth of useful experience data and installation ideas applicable to many types of construction.

Also in August, electrical contractor Bill Schlosser of Madison, Wisconsin, will describe the electrical system design and installation of a "pushbutton" bakery. The job involves dual primary service, air cooled transformers and much automatic control of continuous production bakery equipment.

By September, or soon thereafter, the new 1953 National Electrical Code will be available. From advance information, it looks like the most extensive revision in recent years. For our readers, B. A. McDonald is already preparing a text summary of the more important changes including the background and significance of the new rules. Cooperating with him, B. Z. Segall, author of the monumental two-volume Electrical Code Diagrams, will analyze and explain the changes by sketches and diagrams. The complete report is scheduled to be ready for an editorial feature section in our September issue.



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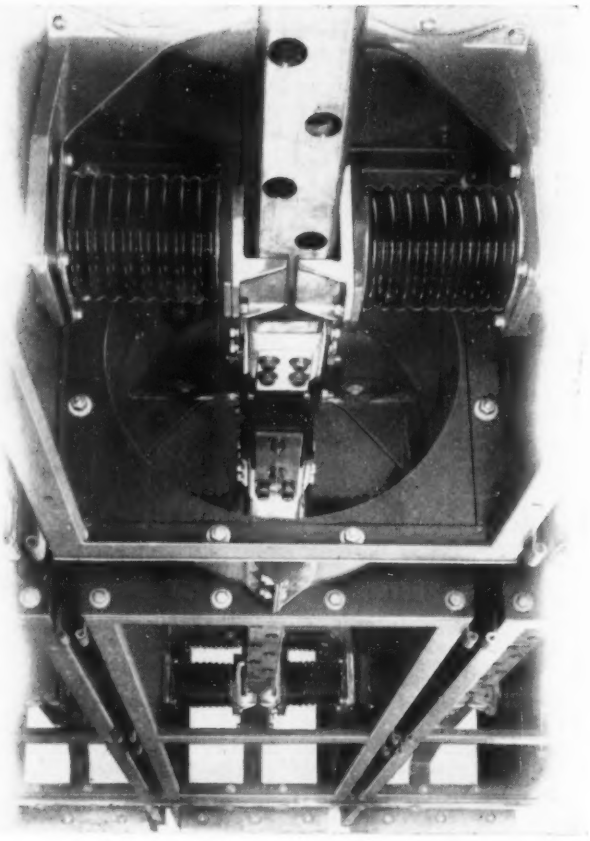

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

52nd Year—JULY • 1953

National Relighting Program

FOR OVER A YEAR a committee of the Commercial and Industrial Lighting Fixture section of NEMA has been working toward a practical, long range, nationwide program for developing and promoting relighting. Research indicates that 85% of existing commercial and industrial lighting systems fall below, and too often way below, accepted industry standards. The need for a planned attack by the electrical industry on a market opportunity of much magnitude is obvious.

EVEN MORE COMPELLING is the public interest in the problem. Proper lighting standards in commerce and industry are of the essence of merchandising, of commercial economics, of working conditions, of productivity and of safety and welfare. The prevalence of modern lighting installations in stores, factories and schools has become a tangible index to civic pride and progress.

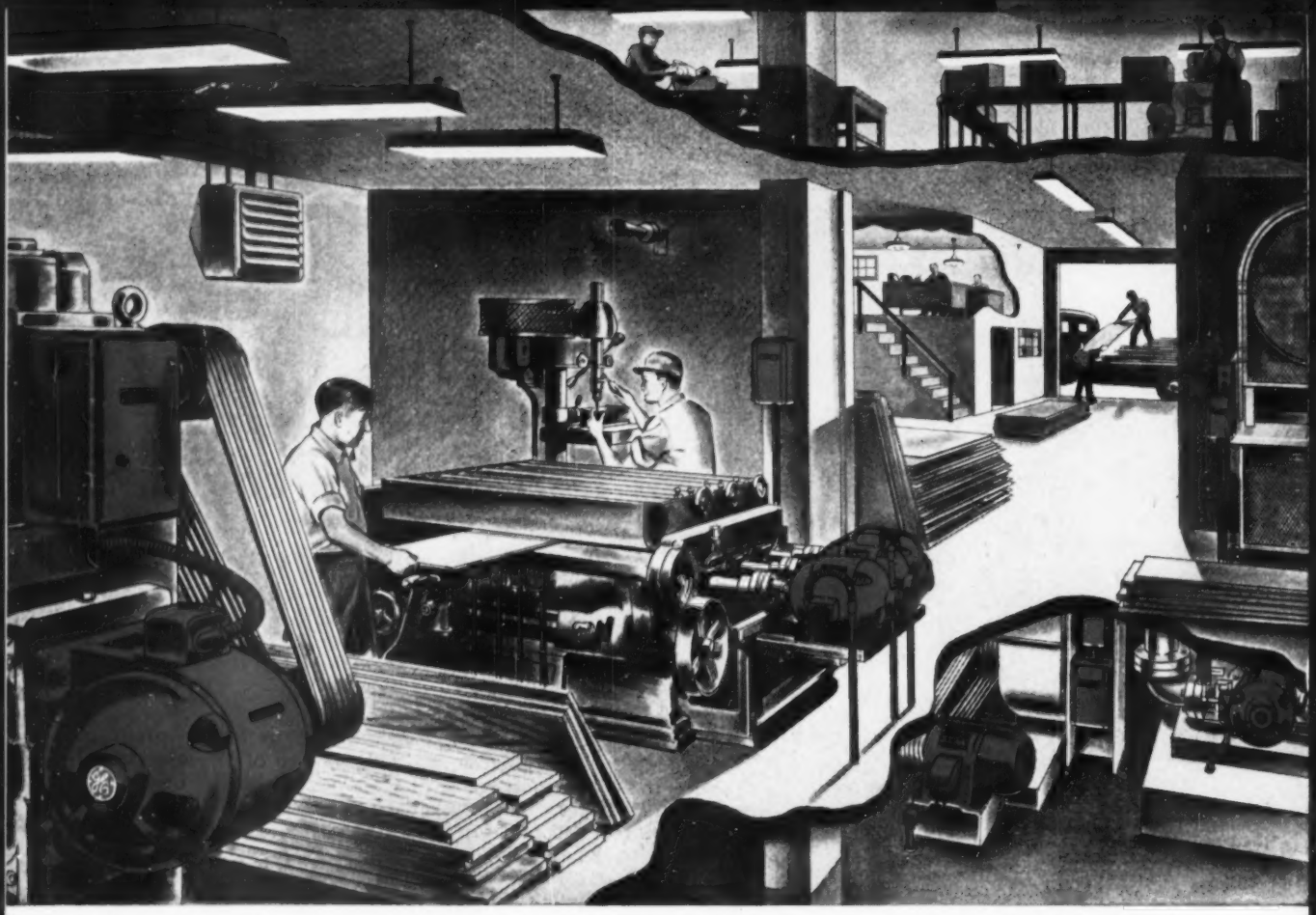
IN SUCH A BENEFICENT ATMOSPHERE, a great market opportunity matched by an equally great public need, why do we want a program? Because modern lighting is art, science and technology. The final result depends upon the individual efforts of many people and of different industry groups. To meet a common responsibility to the public, these efforts need a plan, a direction and acceptable standards by which to measure achievement.

THE NATIONAL LIGHTING BUREAU, proposed by the NEMA committee, is expected to begin pilot operations in the fall. It will be guided by advisors from national industry associations. Its job will be to encourage and guide local industry groups in forming local lighting bureaus.

LOCAL LIGHTING BUREAU PROMOTION will be built around a method of certifying those lighting projects which meet accepted minimum industry standards. Courses in lighting application will be made available to the local lighting bureaus for the training of industry personnel. And as experience and local requirements call for other aids in the future, the program, within its financial limits, can be expanded.

SUCCESS WILL DEPEND upon aggressive local action. Headquarters can fashion fine tools, but they can only be put to work by electrical contractors who in their own communities earnestly want to build profitable relighting business and who are willing not only to meet, but to actively foster and encourage modern standards of lighting application. Those contractors who are now active in creative relighting work will find in the new program a wealth of industry support to their efforts.

Wm. T. Stuart



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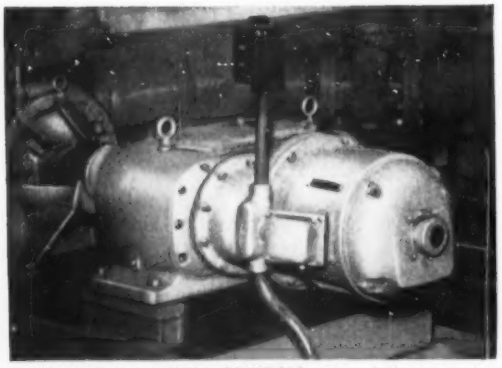
This team pays off in performance



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Graybar distributes the complete line of G-E motors and controls. Your local Graybar Representative can help you select the proper equipment for any machine-drive requirement . . . help you analyze special service conditions that demand totally-enclosed motors, variable speed motors, gear motors, or reversible motors.

Check with him, too, for details on the G-E Motor Exchange Plan. Covering popular fractional and integral ratings, this plan lets you make emergency replacements of inoperable motors through a simple over-the-counter transaction.

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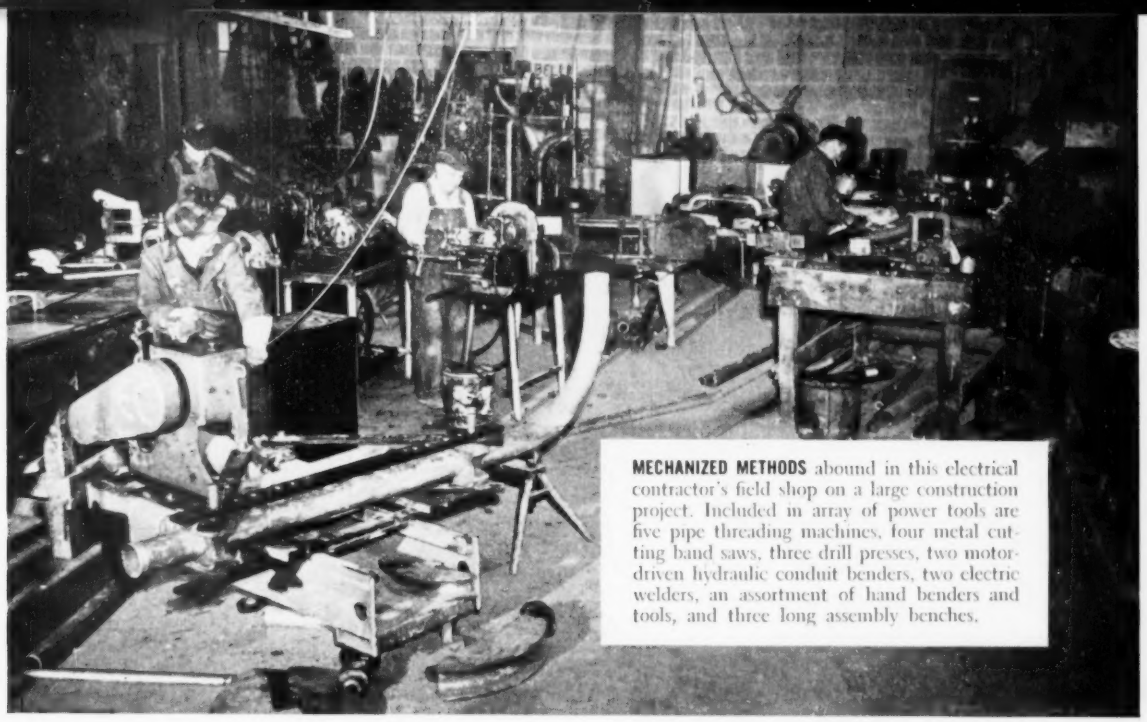


MECHANIZED METHODS abound in this electrical contractor's field shop on a large construction project. Included in array of power tools are five pipe threading machines, four metal cutting band saws, three drill presses, two motor-driven hydraulic conduit benders, two electric welders, an assortment of hand benders and tools, and three long assembly benches.

MODERN Job Tooling and Methods

The electrical construction industry's progressive shift to mechanization is narrowing the gap between a fairly static skilled labor supply and a record volume of construction work. This review of contractor power tooling and installation practices is offered as a guide to those who face the problem of controlling labor hours in the face of rising costs and more intensive competition.

VISIT any electrical construction project, large or small, and study the contractor's field operations. Talk to the electrical superintendent, field engineer or foreman. Watch the mechanics at work and note their physical reserve at the end of the day. Note the types of tools and installation methods in use. Then recall similar jobs installed within the past decade or so and make a mental comparison. You will note that tremendous strides have been made in the technology of electrical construction.

During the war and postwar years, electrical systems became more complex and extensive. This trend is continuing as electrical energy becomes more important to industrial production, commercial enterprises and even the normal living pattern of our people. Today, more than ever before, the electrical contractor has more to do and less time in which to do it. In the face of this, the available supply of skilled labor remains fairly static with a relatively small increase in numbers. True, apprentices are being trained. But, a four-year work and study gap separates beginners from Class-A status. Their impact on the labor market is just that far away. In spite of this apparent manpower handicap, electrical systems are being installed more quickly, more easily, with better quality workmanship and less physical strain on the workman.

Much of this progress is due to a combination of factors. Electrical contractors are mechanizing and organizing their field operations to a higher degree. Products of electrical equipment manufacturers reflect a healthy consideration of installation and maintenance ease. Tool manufacturers are becoming more conscious of the problems and needs of the "pipe" and "mechanical" trades and are producing an array of power tools and accessories which find ready application in this field. The common target is greater productivity per man-hour expended plus an increase in the effective labor supply.

The following pages offer a comprehensive review of what contractors are doing about job mechanization. Actual field photographs illustrate the application and adaptation of power tooling and installation techniques in the various operational categories encountered in electrical construction work. Tool check lists are presented as a guide for building up an adequate tool inventory or for requisitioning tools for projects at hand.

Study these sections carefully. Determine where you can use similar ideas in your own operations, or where you can improve upon those illustrated. Keep this volume in your files as a handy reference guide and a constant reminder to let ingenuity and horsepower replace muscle power in all phases of field work.

RIGHT ANGLE HEAD on electric drill permits boring holes in tight places. Triple-speed feature adds to flexibility of unit.

ELECTRIC HOLE BORER can be used on low-ceiling work or equipped with an extension rod for high stud and joint work.

POWDER ACTUATED TOOL drives ¼-inch threaded studs in steel beam in a matter of seconds. Here single crew installs studs, hangers and tubing.

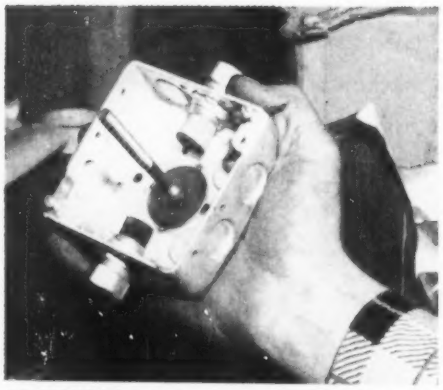
Installation and Fastening

PROBABLY one of the broadest fields of mechanization in electrical construction is that of installing and fastening to building structures electrical equipment, controls, raceways, cables and all the components which constitute a complete electrical distribution system. Although substantial progress has been made in this direction, there is room for continued improvement. Still needed is a universal acceptance by the trade of all tools and accessories now on the market and more research by user and manufacturer to uncover additional operations which can be mechanized profitably.

In this particular category fall those power tools which might be termed "hand" tools—those which, although power driven, are held in the operator's hands and can be used anywhere on the job. Outstanding example is the electric drill which fast became a "must" item in every electrical contractor's tool inventory. On many projects you will find from one to a dozen or more drills of various sizes, speeds and capacities depending upon the type of work involved and the number of mechanics on the job. One contractor with six electric drills on the job increased overall installation efficiency by providing a metal drill carrying box equipped with a complete set of high speed twist drills. Each day each drill kit is charged out against the mechanic using it and he is fully responsible for it. Since he has all the drills he may need, frequent returns and visits to the field shop are eliminated.

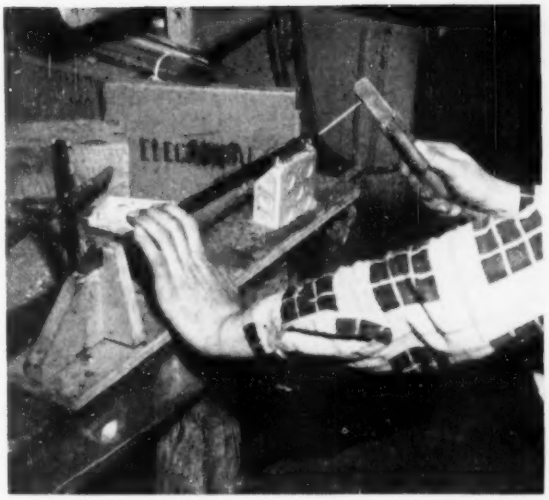
Noticed on another project where continuous-line production machinery was being installed and connected were a number of dolly-carts which mechanics used to move their drill kits and tool boxes along the line.

The increasing large number of attachments and accessories now available make the electric drill an even more versatile power tool than in the past. Right-angle heads with speed changing features allow working in tight places. Metal cutting hole saws, circular saws and reciprocating saw blade units permit cutting operations which formerly required multiple drilling and hand sawing. Handy bench stands transform the unit into a drill press for bench operation. Long extension arms convert right-angle head drills into efficient overhead hole borers. The use of carbide tipped drills, and core drills with diamond cutting edges extend the use of power drills to concrete and masonry work.



RETAINING BOLT screws into threaded stud on back of this box; holds outlet box tight against plywood forms for flush installation in concrete columns. Bolt assembly is unscrewed after forms are removed.

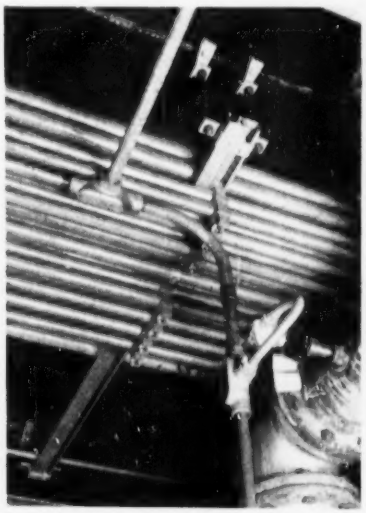
STUD DRIVER, actuated by powder cartridge, fastens metal box to masonry wall in a single, quick operation. Standard head studs are used for box, threaded studs for strap. Tool works equally well on brick, concrete and steel.



ELECTRIC WELDER is used to tack channel-iron "stems" to outlet box for rigidly supporting outlets on building deck during concrete pour. Groups of boxes are "made up" in contractor's field shop.

RATCHET SCREWDRIVER speeds up circuit connections to wiring devices; cuts time necessary to complete trim work on projects.

WIRE STRIPPERS replace pocket knife for skinning insulation off conductors. Tool does the job quicker and without danger of nicking metal.

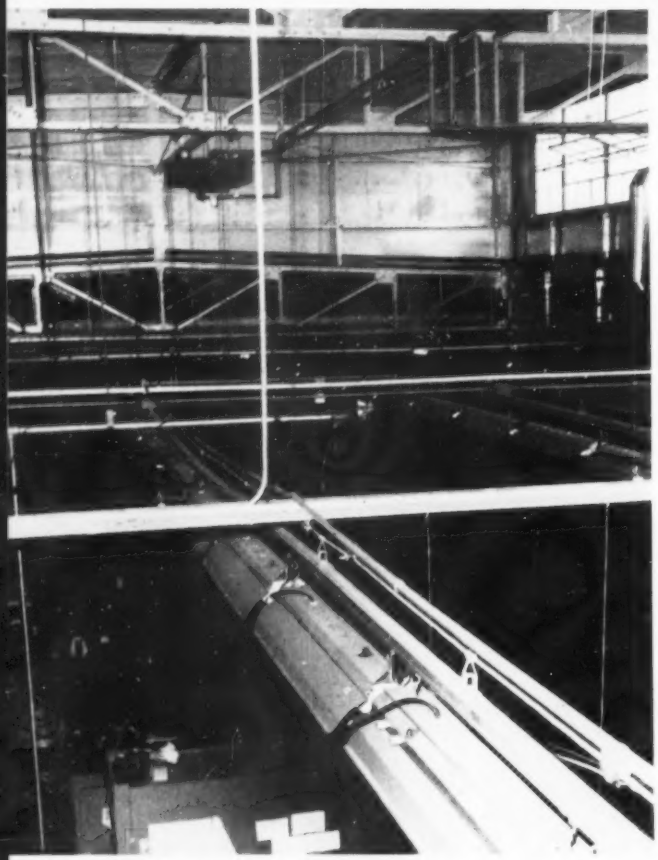


CONTINUOUS CHANNEL TRAPEZE hanger mounted with beam clamps and equipped with adjustable pipe clamps supports group of conduits.

Also used for a variety of cutting, drilling and installation operations are the electric hammer, electric impact tool, electric nut-runner and screwdriver. Hammers are available in two designs: the solenoid type with its natural reciprocating motion and the electric motor type with a mechanism to convert rotary motion to sharp hammer blows. Impact and nut-running tools have high torque characteristics and clutch release mechanisms which permit tapping, nut-running, screw driving and similar operations.

Of equal importance with the selection of the proper electric power tool for a given job is the choice of a tool of adequate size and capacity. A tool which is too small for the job will cause grief and may well nullify its cost-cutting features. Adequate maintenance is another item which must be considered. Many contractors maintain special repair departments to keep all power tools in perfect operating condition.

Undersized extension cords is an important item too frequently overlooked by contractors. Voltage drop will lower the efficiency of a power tool just as effectively as a dull twist drill. Use the accompanying table as a guide



MESSENGER CABLE SYSTEM supports continuous row of fluorescent fixtures below and a conduit run in an industrial plant installation.

to selection of proper size conductors for long extension cords. For safety reasons, portable electric tools should always be grounded, either by means of a three-conductor cord or separate grounding conductor. Some states, among them California, have laws making this mandatory.

Oxyacetylene torches, where permissible, provide about the quickest method of cutting steel—particularly where openings must be fairly large for passage of conduits and raceways. Permission to do this should be obtained from the architect or engineer in charge of construction as many structural designers will either limit or entirely prohibit this practice. Basic reason is to maintain the original design strength of the steel structure. Frequently such restrictions will extend even to drilling or punching of steel to accommodate bolts for conduit straps, brackets or other equipment. Under such circumstances, beam clamps, welding or studs driven by powder-actuated tools offer an alternative method for installing and fastening equipment.

A fairly extensive variety of beam, C, pipe and other clamps are available for mounting practically everything from conventional outlet boxes to heavy conduit and equipment items. Although normally considered a material item, they constitute a method of installing and fastening. Also falling in this classification are such items as concrete inserts, continuous channel framing, angle and channel iron. The latter are often installed to form rigid supports for conduits, fixtures, etc., where long spans must be bridged and the number of suspension rods kept to a minimum. They also are used to fabricate mounting frames for equipment and controls, individually or in groups. Continuous channel framing, with its sliding nut and bolt attachment feature, offers a substantial labor economy since no pre-measuring, punching or drilling are required. Choice of method depends upon the economics of the job at hand.

Welding equipment, oxyacetylene and electric arc, is becoming increasingly popular as a contractor "tool" both

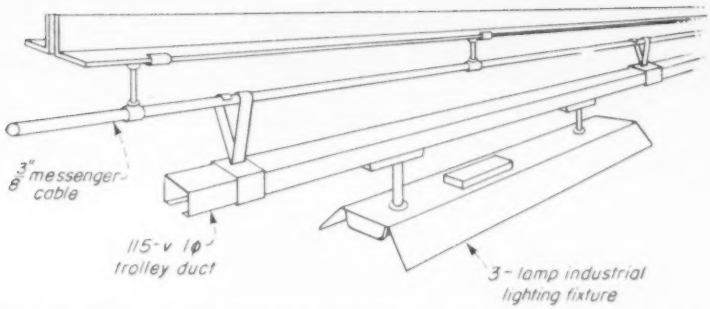
SIZE OF EXTENSION CABLE FOR PORTABLE ELECTRIC TOOLS

Based on current equivalent to 150 percent of full load of tool and a voltage drop of not over 5 volts.

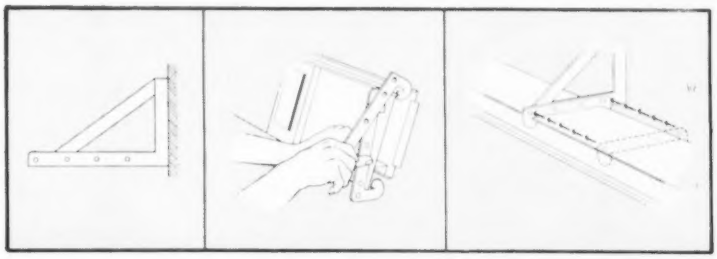
This table is for 110-volt tools. For 220-volt tools use wire size corresponding to an extension length of one-half the contemplated length.

Full load ampere rating of tool	0—2.0	2.1—3.4	3.5—5.0	5.1—7.0	7.1—12.0	12.1—16.0
Distance—Feet (one way)	Wire Size (B & S Gage)					
25	18	18	18	18	16	14
50	18	18	18	16	14	12
75	18	18	16	14	12	10
100	18	16	14	12	10	8
200	16	14	12	10	8	6
300	14	12	10	8	6	4
400	12	10	8	6	4	4
500	12	10	8	6	4	2
600	10	8	6	4	2	2
800	10	8	6	4	2	1
1000	8	6	4	2	1	0

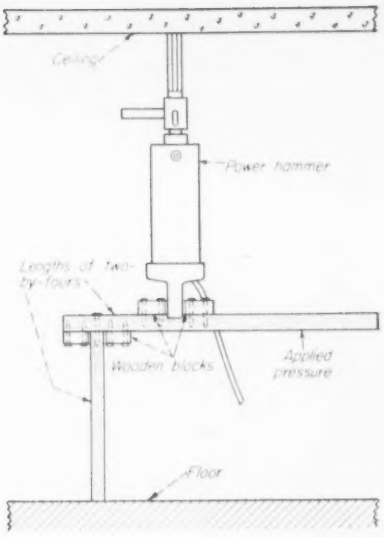
NOTE: If voltage is already low at source (outlet), have voltage increased to standard, or use a much larger cable than listed in order to prevent any further loss in voltage.



SPECIAL CLAMPS provided by equipment manufacturers permit quick and easy installation of messenger cable, trolley duct and fixtures.



IT'S A SNAP to fasten bus duct to brackets with special clamps that grip duct edges and can be bolted to supporting medium.



UPWARD PRESSURE on power hammer drilling concrete ceiling can be applied with lever bar on pedestal fulcrum. Variation of idea is to use small hydraulic jack mounted on sturdy pedestal and equipped with saddle to hold hammer grip.

in shop and field operations. Both are used extensively in the shop for fabricating brackets and similar items. Electric welding finds greater application in the field since it is easier to work with, particularly in high locations. Units are used both on the job and in the field shop for a number of fabricating and mounting operations.

A favorite tool among a number of electrical contractors is the electric stud welder. With it a threaded steel stud can be welded to any steel surface, either beams, columns or base plates, in a fraction of a second.

Among the split-second fastening tools becoming more popular in the electrical construction field are a group of powder-actuated stud drivers. These units are light in weight, can be used overhead, on walls or floors and have the added advantage of driving studs into either steel or masonry construction. Actual driving force is produced by a powder filled cartridge. Up to six different powder charges are available to provide the proper powder load for the material into which the stud is driven and the desired depth of penetration. A large choice of stud fastenings range from the standard head type for direct fastening of boxes and mounting clips to external and internal threaded studs of various lengths. One model tool offers as accessories a number of special guards designed for direct fastening of outlet boxes, conduit clips, continuous channel framing, conventional channel and angle iron. Continuous development of this type of fastening tool during the postwar years and the addition of new safety devices has erased much of the original reluctance on the part of contractors and mechanics to take advantage of its substantial time-saving features.

While tools are playing a major role in slashing installation costs of electrical systems, contractor ingenuity (in the form of installation engineering) and manufacturer cooperation (in the form of products designed for easier installation) have contributed to a substantial extent.

TOOL CHECK LIST

Ackerman Sets
Braces, *ratchet*
Burners, *acetylene, gas*
Clamps, *C, beam, pipe*
Continuous Channel Framing
Cords, *electric extension*
Crimping Tools
Drills, *wood, masonry, steel, twist, star, core, tall reach, Carboloy tipped, diamond core.*
Drills, *manual*
Drills, *electric—high speed, slow speed, impact type*
Drivers, *stud—powder actuated*
Electric Welders, *stud*
Goggles, *safety*
Gloves, *safety*
Hammers, *manual, electric, pneumatic*
Nut Runners, *electric, pneumatic*
Screw Drivers, *hand, ratchet*
Screws and Bolts, *assorted*
Stock, *bolt, angle, channel*
Taps and Tap Wrenches
Torches
Welding Equipment, *electric, oxyacetylene*

Special installation methods devised by contractors to solve perplexing mounting problems cannot be overlooked; neither can the variety of clamps, clips, hangers and other mounting devices developed by the manufacturers for their own equipment items. Net result of this cooperative endeavor is recognition of the electrical industry as one of the most progressive in the construction field.

PLATFORM BOOM on industrial electric truck speeds relamping or replacement of lighting fixtures, installation of new conduit or other electrical work. Platform has brackets to support lamps, fixtures or conduit.

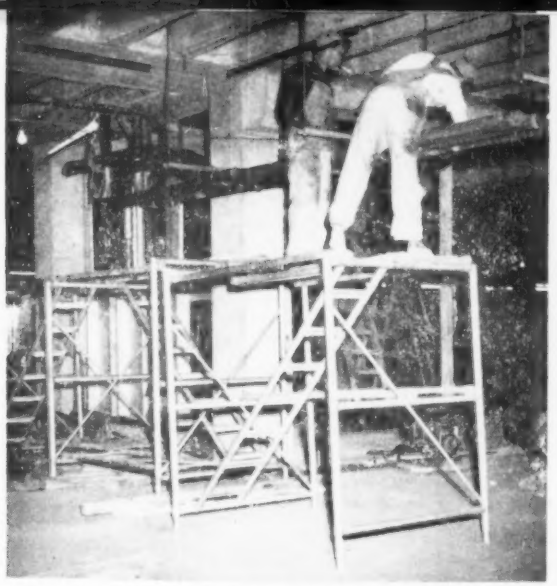
Scaffolding and Rigging

SCAFFOLDING and rigging are important "tool" items for electrical construction and maintenance work. Conduit circuits, both feeder and branch, are generally installed overhead or along walls near the ceiling line. The same holds for bus duct and trolley duct for power and lighting. Even when most of the raceways are in or under the floor slab, overhead lighting conductors and fixtures must be installed. Some type of scaffolding is needed on practically every electrical construction project. Makeshift systems of questionable safety are a definite hazard and liability. Unless mechanics working in high areas are sure of their footing, man-hours will climb, workmanship will suffer and anticipated savings from use of power tools may be nullified.

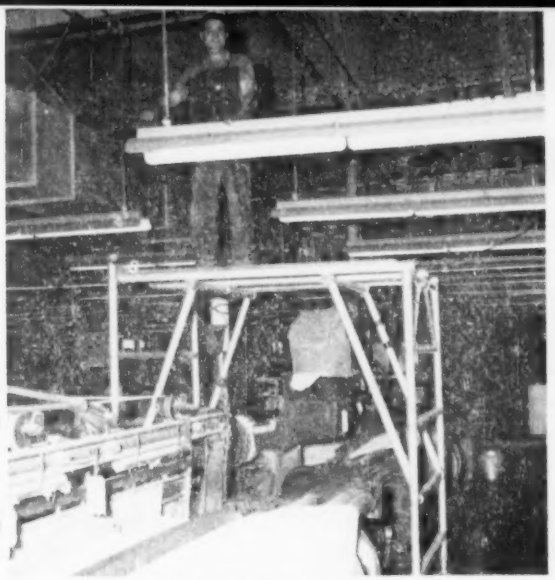
Safety is a prime consideration in the assembly of any scaffolding system. In the electrical field, due to the nature of construction operations, the following additional features are required: erection and dismantling speed; light weight (without sacrifice of strength and safety) for easy portability from job to job; flexibility and adjustability to meet various height and uneven surface conditions; and mobility on the job so the unit can easily follow installation operations.

A number of sectionalized scaffolding systems now on the market meet these specifications and are finding ready acceptance by contractor and maintenance departments. They consist of basic one-piece sections which can be quickly assembled into complete units in a matter of minutes. With the addition of standard sections, working platforms of practically any height and width can be constructed to meet specific installation conditions. Pin and coupling joints eliminate the need for erection tools and adjustable legs have locking casters for mobility.

Most popular among electrical contractors are the lightweight aluminum alloy units (one-third the weight of steel and just as strong) which require almost no maintenance. One folding section unit (4½-ft. wide, 6-ft. high, 6-ft. wide) seen on numerous electrical projects weighs only



WORKING PLATFORM is made by placing three sections of aluminum scaffolding end-to-end. For high-bay areas, scaffold sections can be quickly placed one on top of the other to form sturdy platform.



HIGH CLEARANCE SCAFFOLD straddles machinery in a textile mill while electrician works on lighting fixture. Platform is adjustable from 7 to 9 feet through adjustable legs equipped with casters which can be locked.

STEP LADDER with broad platform and extended sides helps mechanic maintain balance while reaching work; also facilitates addition of painter's extension scaffold between two ladders to form walkway.

SPECIALLY DESIGNED rolling platform for fixture installation uses continuous channel framing uprights so platform can be adjusted, by inches if necessary, to most comfortable working position for mechanic.

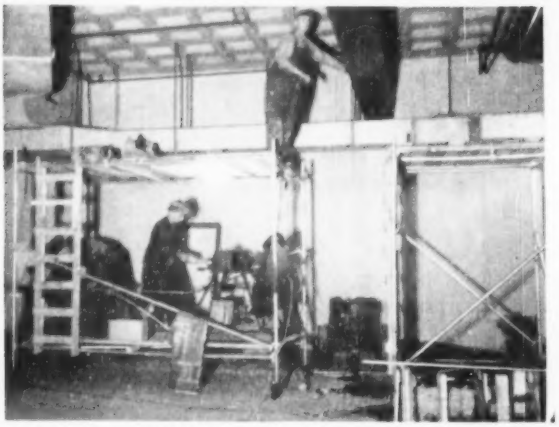
64 pounds, can be assembled in one minute, and features an "inside" built-in stairway which also serves as diagonal bracing.

Once scaffolding is in the shop or on the job, adaptation to installation operations is limited only by the ingenuity of the user. Seen on one project was a dual-platform scaffold functioning as a rolling workshop. On a lower platform were a tool box, power vise, conduit tools and a crew to cut, thread and bend conduit which was then handed to mechanics on the top platform for immediate overhead installation. For wire pulling, two rolling scaffolds were used with a bridging platform to span outlet centers. One of the scaffolds was equipped with a conductor pay-out rig holding several reels of branch circuit wire.

Or consider the midwest electrical contractor who extended the versatility of his rolling scaffold by adding a motorized platform hoist to one side (illustrated in a later section). Now the mechanic on the scaffold can also raise and hold heavy bus duct or conduit sections into assembly position.

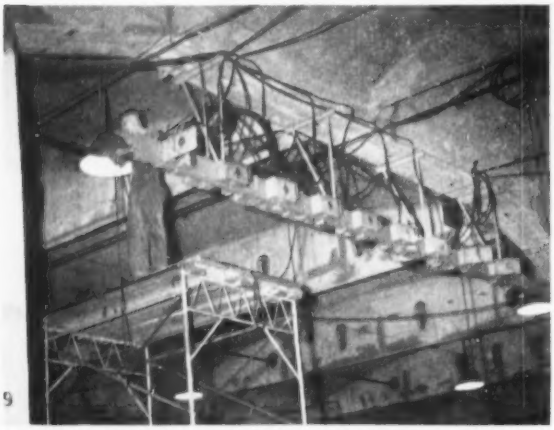
A west coast contractor decided that muscular fatigue can be costly; that a man cannot work efficiently in a reaching position. So he built several rolling platforms with continuous channel framing uprights for installation of fluorescent fixtures. The platforms can be raised or lowered, by inches if necessary, to fit the height of the installation team. Mechanics work with ceiling outlets near eye level and can cradle the fixture on one arm while attaching the stem with the other hand.

Frequently a bit of forethought and construction analysis by a contractor's project supervisor or field engineers can save a substantial block of man-hours. One case in point is that of a midwestern firm whose engineers stole a big jump on other trades during the construction of a large-area, flat roof industrial plant. The engineers designed a "beam buggy" to speed installation of conduit and fixture supports to the roof steel. The four-wheel rig



ROLLING WORKSHOP is formed by this dual-platform scaffold. Lower platform has power vise and tools for cutting and threading conduit. Mechanic on top installs conduits and outlet boxes prepared below.

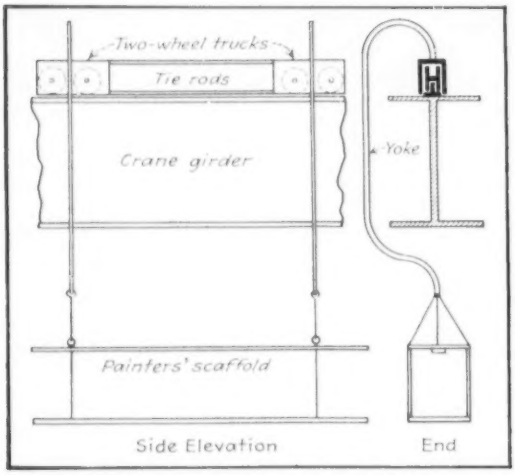
IT'S EASY TO GO in and out of doors and down narrow corridors with this light-weight, narrow rolling scaffold. Mechanic on ground prepares conduit and moves scaffold while man on platform installs the raceways.



A SOLID FOOTING on this high scaffold gives the electrician confidence as he works on plug-in circuits in a high-bay area.

TOOL CHECK LIST

Beam Buggies, *overhead type, monorail suspension type—to work above or below roof steel before or after roof is in place.*
Ladders, *step, A, rigid, extension*
Platforms, *single, extension—painter's type*
Scaffolds, *adjustable, rigid, rolling, stationary, sectional telescopic*
Towers, *rolling, hydraulic lift type with platform*
Trucks, *fork lift, platform boom, telescopic ladder*

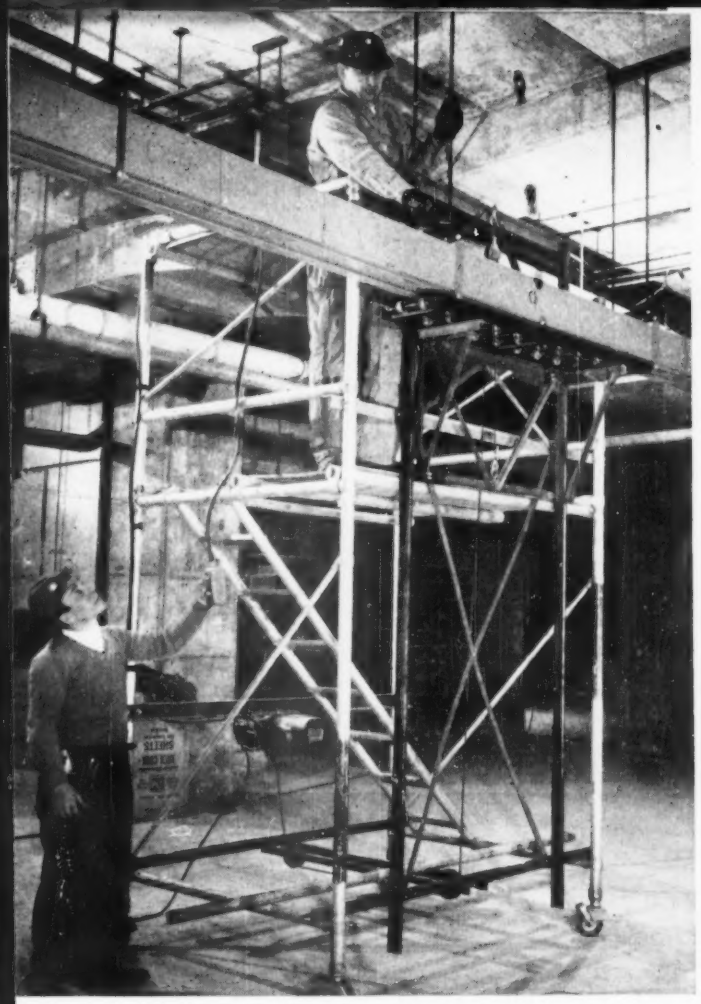


MOBILE RIG suspends painters' scaffold from crane rail. Suspension yokes mount to two two-wheel trucks which ride rail. Offset in yokes positions scaffold under crane girder and close to building columns where electrical work is being installed.

(flanged wheels) rides the top of the steel beams before the roofing material is installed. Electricians seated in the rig lean down between guard rails and mount suspension clamps and rods to the underside of the steel beams. On another project one-man, monorail cars suspended from the underside of high-bay roof beams were used.

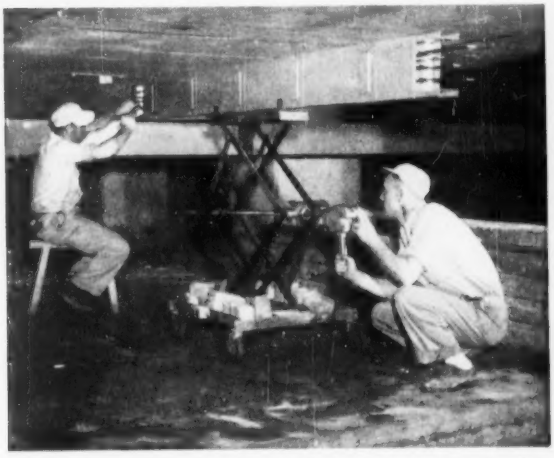
In some cases standard scaffolding systems, even high-clearance units, cannot be used effectively. Congested areas with tall machinery in place or storage areas with limited traffic aisles are typical examples. Under such conditions, boom platform trucks (either single or double platform) are used for installation and maintenance work. When work is overhead and there is no need to boom over obstacles, hand or motor operated hydraulic tower lifts provide a safe and speedy way to elevate mechanics within reach of the work. Truck elevator platforms, telescopic aerial ladder trucks and similar equipment are used extensively for outdoor work.

This discussion is not intended to imply that step, A and extension ladders are on the way out. There will always be a need for them in electrical construction work and they will always form an important part of a contractor's tool inventory.



PLATFORM HOIST mounted to side of lightweight rolling scaffold raises and holds bus duct sections in position while mechanic makes connections. Motor-operated hoist is controlled by push-button station on heavy extension cord. Platform is section of wheel conveyor to facilitate rolling duct section on hoist. Special metal end plates with V-section cut and roller bearing saddles are added to platform when using heavy conduit.

FORK-LIFT TRUCK maneuvers heavy equipment around contractor's shop area; transforms equipment handling into a one-man operation.



SCISSORS JACK with elevating screw operated by standard ½-inch electric drill cut bus duct installation labor in low-clearance areas an estimated 33 percent. Pantograph platform has saddle to hold duct. Jack rests on rolling base equipped with swivel wheels and brakes, convenience outlet for drill and work lamp, parts tray for bolts, washers and nuts. Jack is lowered by attaching drill to other end of elevating screw.

MODERN Job Tooling and Methods

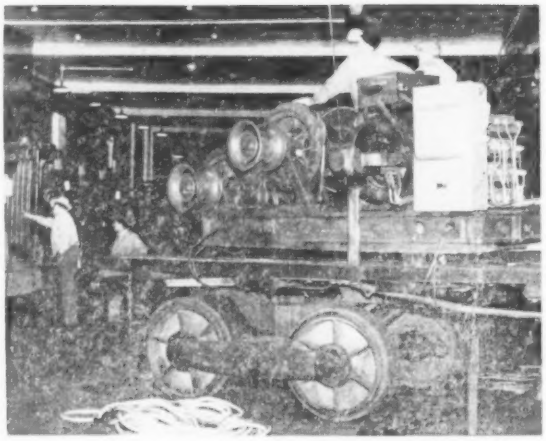
Material Handling

ON-THE-JOB handling of materials and equipment (from delivery point to storage to work areas to installation position) can, if permitted, absorb a good portion of over-all electrical construction labor costs. The magnitude of this specific labor segment will vary with the type of job (single or multiple story, commercial or industrial), construction features, size of the project and relative amount of construction materials and heavy equipment involved in the electrical system. Some estimates indicate that in the pre-mechanization era when hand labor abounded, this figure could have been in the neighborhood of 20% to 25%. Those were the days when conduit was carried by hand, heavy switchboards and transformers laboriously dragged into position on rollers and skids with muscle power on the rope end of a block and tackle.

Today, better job management, mechanized techniques and modern job methods have slashed this figure to an average of about 5% of total job labor. Because of the number of variables which enter the picture, this figure may seem high to some, low to others. It does, however, emphasize what can be done with mechanized equipment.

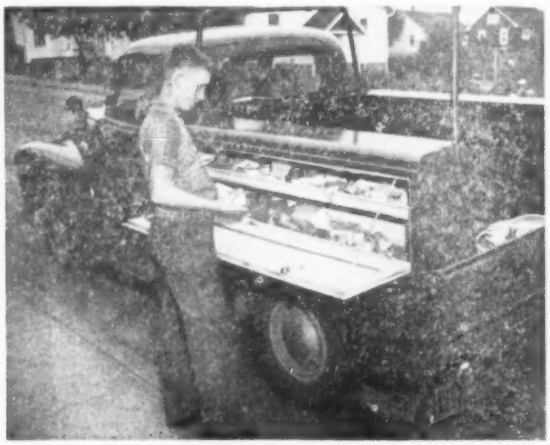
Biggest contrast, perhaps, is noted in the handling of heavy equipment. The old method of skidding switchgear off a flat car gave way to boom cranes which, if construc-

SEMI-TRAILERS, large and small are becoming the popular means of transporting materials and tools to job sites. They are particularly effective and economical on street lighting projects where mobility is desirable.



ELECTRIC WINCH on trailer hoists heavy transformers and other equipment up through center court of a multi-story commercial building to substation locations on upper floors.

DOUBLE-DECK TRUCK with adjustable rear boom attachment is used by electric service firm for pick-up and delivery of transformers. Other trucks are equipped with hydraulic tail gate which acts as a lift platform for heavier units.



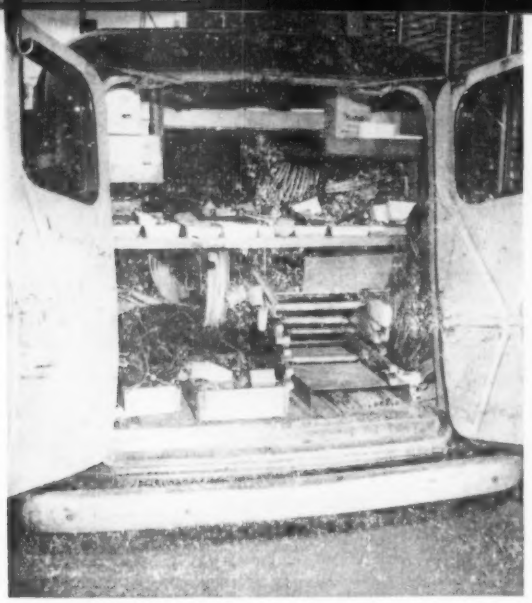
SUBSTANTIAL TIME-SAVER is this type of service truck with tool and material compartments on both sides plus overhead pipe and ladder rack. Heavy material and cable go in truck body, power tools and wiring parts and accessories in locked side compartments.

tion were not too far advanced, could lower it through the building steel to the point of installation. One contractor reports he now uses a 20-ton fork lift truck to "carry" a complete unit substation from rail siding to mounting bolts. Think of the time saved in that one operation alone.

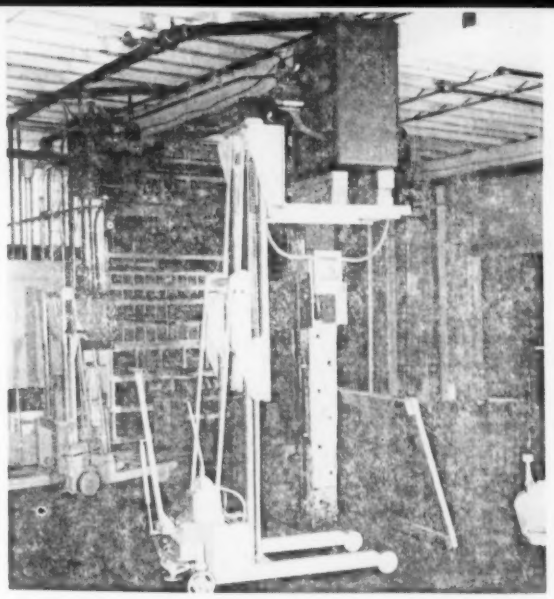
Cost-cutting need not be limited to handling of heavy equipment. There are a number of ways to efficiently handle the variety of other materials which go into a complete electrical distribution system. Dollies and flat-bed hand trucks provide about the least expensive method (from tool investment standpoint) of moving material. You will find several of these on almost every job. The next logical step toward mechanized material handling is the motorized flat-bed truck. If elevating features are required, the fork lift truck—either hand or motorized—is the answer. Again, choice of truck type will be guided by the job to be done.

Sectionalized roller conveyors can be found on a number of construction projects, particularly where pre-assembly and pre-fabrication techniques are employed. They offer a quick and practically effortless method of moving conduit assemblies, bus bars, bus duct and a number of other items from the assembly or storage area to point of installation. They find frequent use in long underground tunnels where conduit and cables are to be installed on wall racks. One midwest contractor used this technique to "roll" long sections of heavy copper bus across a series of open tanks for installation on the opposite side of a basement room.

Contractor ingenuity in the material handling realm has led to the development of unique equipment and methods. One example is the scaffold-mounted, motorized lift platform mentioned earlier. With it the mechanic can raise a section of heavy bus duct (which has been rolled on to the section of wheel conveyor forming the

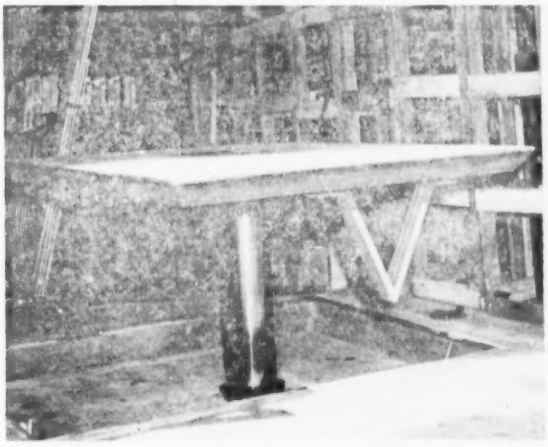


PANEL TRUCK fitted with shelves, racks, troughs and trays gives ready access to tools, ladders, conduit, cable and other wiring accessories. Truck is used by contractor specializing in residential work.



HAND-operated fork truck lifts unit heater fan into position for installation. Truck can be used equal y well as a materials handling unit or a lift platform for mechanics' maintenance and installation operations.

METAL TOOL BOX on casters serves equally well as a tool or material storage unit on construction projects. Mobility feature permits unit to be rolled from room to room on commercial and apartment building projects, eliminating unnecessary walking back and forth.



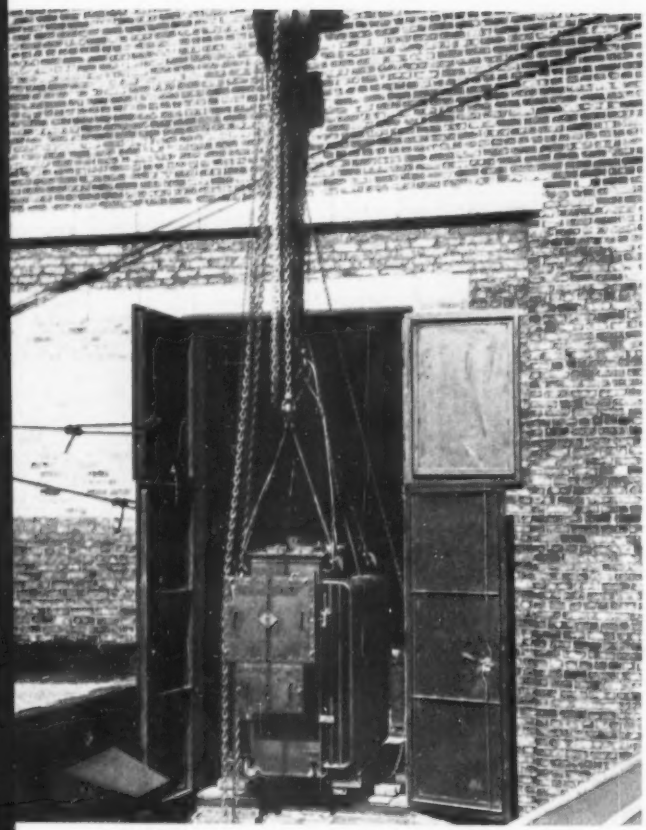
HYDRAULIC PLATFORM slashes time required to load and unload trucks in delivery area of a contractor's shop. In this position, off-center platform extends beyond door to meet truck bed. When not used, platform is turned 90-degrees clockwise and retracts flush with floor.

platform) and raise it, by push-button control, to precise assembly height and make the necessary connections. Special end plates with a V-slot and ball bearing "seat" are attached to the lift for use with heavy conduit. Once in position, the conduit can be easily turned and coupled to sections already in place.

Another contractor, faced with the problem of mounting bus duct to a 4-foot ceiling under the main floor of a plant, designed a giant-size scissors jack operated by a conventional ½-inch electric drill. With practically no effort, mechanics could raise heavy bus duct sections into assembly position. This bit of ingenuity saved the contractor one-third of his estimated bus duct installation labor.

More effective dispersal of materials at the job has done much to cut handling costs. For small projects, one central warehousing point—usually the contractor's field shop—still works well. On large projects, such as modern large-area industrial plants, several warehousing points strategically located at the center of heavy installation areas reduce overall material handling time and costs. Frequently, these area material cribs are also subdistribution points for tools and handy field offices for crew foremen. Metal boxes on casters, which can be readily moved from area to area or room to room, are being used on many jobs to store tools, boxes, coils of wire and other small material items. On multi-story construction the electrical contractor normally uses the builder's material hoist to transport heavy tools and equipment from floor to floor. On other occasions portable electric winches and block-and-tackle do the job.

Close job supervision permits alert contractors and field supervisors to spot operations which can be effectively mechanized. Those who accept the challenge, however small, reap the benefits of resultant lower installation and operating costs.



CHAIN HOIST, steel cable slings, and pipe rollers are used to ease this large transformer into upper-floor substation enclosure.

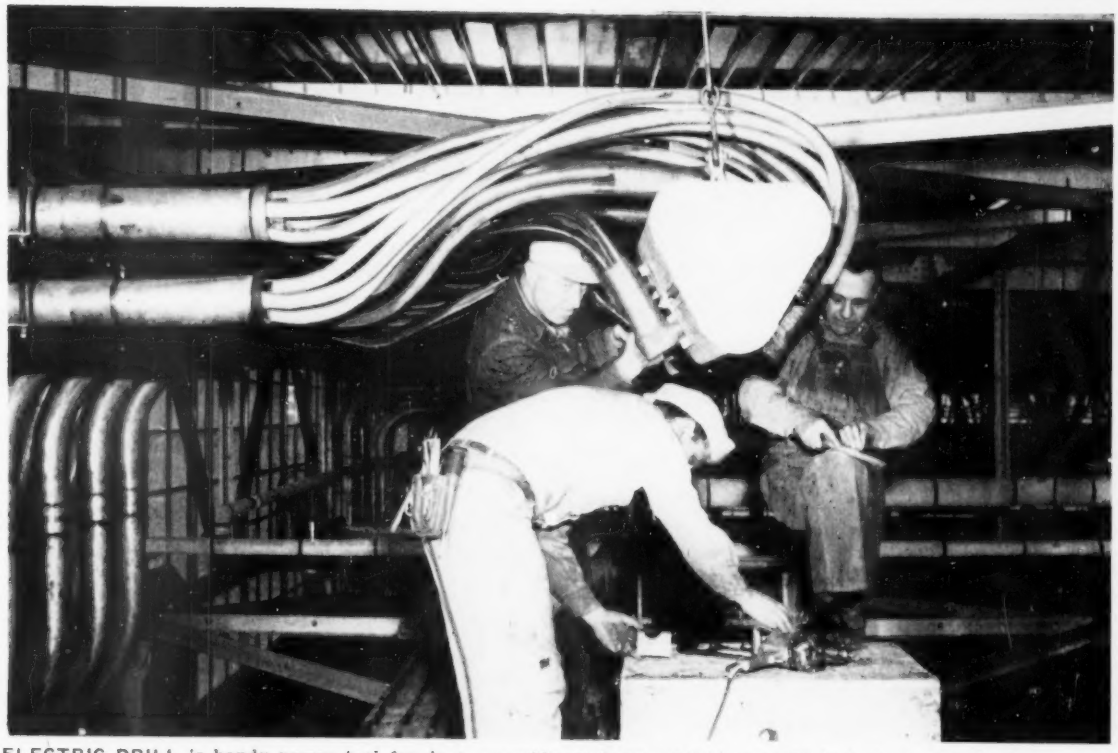
HAND TRUCK with a 16" x 20" hydraulically powered, chain actuated lift platform permits one man to load or unload equipment from truck and spot it anywhere in a building. Rubber-tired unit has a 500-pound capacity, elevation range of some 36 inches, and a platform rest which acts as a stabilizer when truck is in vertical position. When used on delivery or pickup truck, unit replaces hoist assemblies or skids.

TRAILER PICK-UP body, designed originally for street lighting construction, was also used to transport tools and materials to and along construction route.

INTERIOR OF A 28-foot, semi-trailer which serves as a combination field office and shop. Bins on left hold conduit fittings and wiring accessories.

TOOL CHECK LIST

Bins, *materials and parts storage—wood and metal*
Blocks, *snatch*
Block and Tackle
Boxes, *storage, stationary, rolling—wood and metal*
Chains
Conveyors, *roller, wheel*
Cribs, *stock—wood and metal*
Cranes, *chain, floor and overhead — manual and power driven*
Dollies, *small and large*
Hoist, *chain, manual and power driven*
Jacks, *screw, reel, gang—manual and hydraulic*
Lift Platforms—*hand or motor or hydraulic operated*
Reel Rollers
Rope, *hemp, wire*
Slings, *rope—hemp and steel*
Tongs, *chain*
Trailers, *highway type for tool and material storage*
Trucks, *wagon, industrial, fork lift*



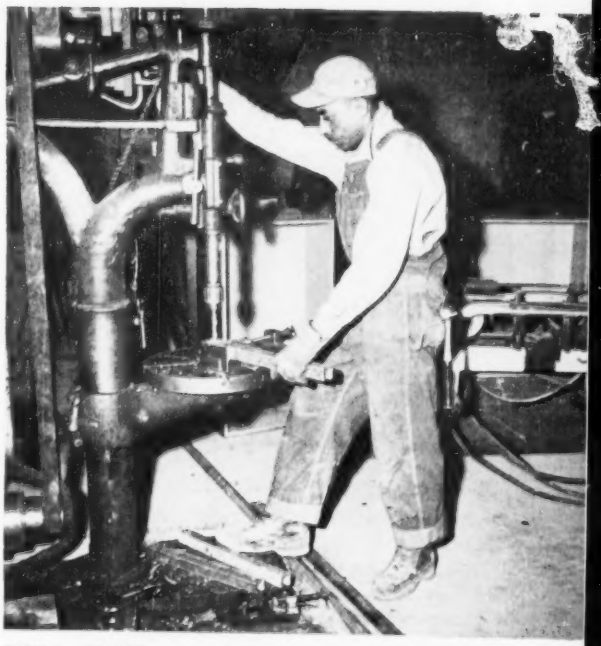
ELECTRIC DRILL is handy power tool for duct assembly work on scaffold some 60 feet above floor level.

Assembly Techniques

PRE-ASSEMBLY and pre-fabrication operations constitute one of the most effective combinations of power tooling ad advanced installation techinques in the electrical construction field. Wartime experience proved that pre-fabrication and assembly methods long used by industry could be adapted to construction to speed installation and lower ultimate costs. Modular design of housing developments, office structures and industrial plants offered numerous opportunities for mass fabrication and assembly. The electrical construction industry was quick to adapt such techniques to its own operations. Because savings in time alone were so great, the age-old practice of piece-by-piece installation of system components was quickly abandoned.

As a result, contractors' field shops today are small scale assembly plants. The trend is to concentrate repetitive operations at one point, to do as much work as possible at ground level and distribute assembled units to installation points. Power tools can be concentrated in one area instead of being scattered throughout the project. Less experienced mechanics can be quickly trained and assigned to mass fabrication and assembly operations. Thus, more effective use of available skilled manpower supplements the inherent savings in man-hours.

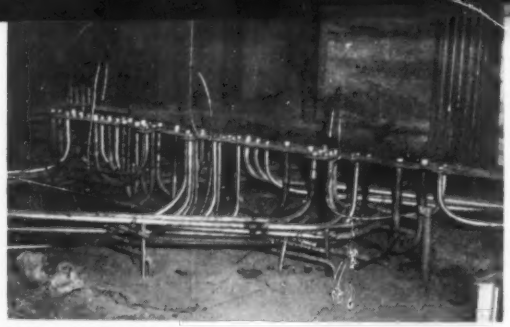
Most adaptable to assembly techniques are the fabrication of brackets, racks, frames, suspension rods and other supporting assemblies for installation of equipment. Fabrication of bus bar systems (cutting, drilling, bending), particularly on large projects, is usually done in the field



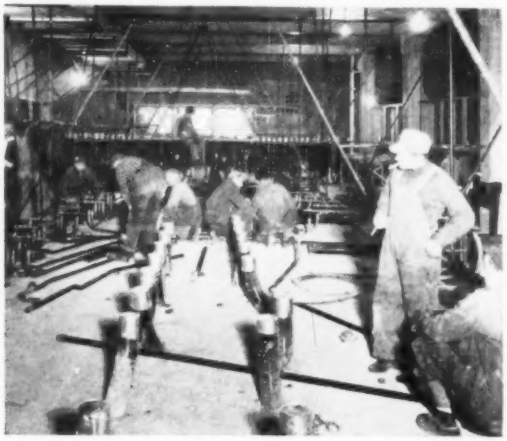
DRILL PRESS, one of three, in contractor's field shop is used constantly in shop fabrication of various types of brackets, hangers and supports for conduit, cable and other electrical equipment.

MODERN Job Tooling and Methods.

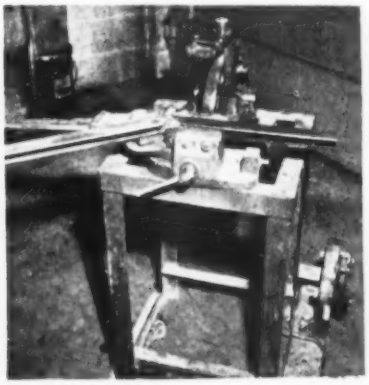
ONE PULL on lever shears angle-iron quicker than it could be cut with hand or power saw. Saves fabrication time for various types of panel and equipment supporting brackets.



STEEL TEMPLATE aligns conduits for base of control equipment enclosure, keeps stub-ups from shifting during concrete pour.



PIPE RIGGING suspended from ceiling beams hold conduit stub-ups in special templates before final pour of concrete floor. Rigging was quickly dismantled before switchgear was set in place.



SHEAR TABLE also has punch to notching angle iron and hand bender to form right angle bends; slashes bracket and frame fabrication time.

BOX ASSEMBLY complete with plaster ring sealed with masking tape and tubing connectors is ready for installation in concrete column forms.

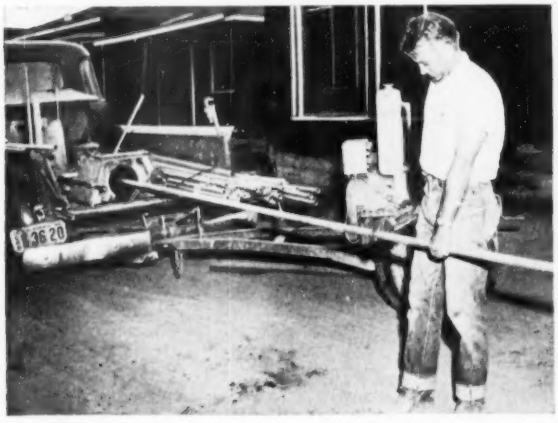
PRY-OUT cover on outlet box plaster rings protects box and conduits during plastering. Bell-shaped protrusion keeps plasterer from covering outlet.

shop. Mass bending of conduit and tubing offsets for parallel runs of grouped conduits can also be done more efficiently in the well equipped field shop.

To keep pace with this trend, contractors are equipping their field shops with a larger variety and greater number of power and hand tools. Noted in one shop on a large construction job were five pipe threading machines, four metal-cutting band saws, three drill presses, two electric welders, two motor-driven hydraulic conduit benders, several motor-driven grinding wheels. In addition there was an assortment of hand benders (conduit and copper) and hand tools plus three long assembly benches. With such a variety of equipment at hand, there was never a mechanic standing in line waiting to use a machine. To some, this may seem like going overboard in respect to equipment. But, there were almost 200 mechanics on this project and the contractor wanted to back them up with adequate tools.

Not all assembly work must be done in a field shop. One west-coast contractor introduced power coupling of con-

PRE-ASSEMBLY of service conduit meter box and conductors at field shop cut installation time to a minimum on housing project. Service assemblies were delivered to house and mounted in about 10 minutes.



POWER COUPLING of conduit is accomplished by using power vise, on truck bed, operated by gasoline generator on trailer. While first sections of conduit rotates in vise, mechanics couple additional lengths as they walk back.

duit on a street lighting project. By mounting a power vise on a pick-up truck and towing a generator (gasoline driven) trailer he was able to cut conduit installation time to a minimum. The mechanic tightened the first length of 1-inch conduit in the power vise. As the conduit slowly revolved, the two mechanics worked their way back some 300 feet coupling additional lengths as they went along. The conduit has been previously spotted between pole locations. Under normal conditions, this team coupled 300 feet of conduit in about 15 minutes and did better than

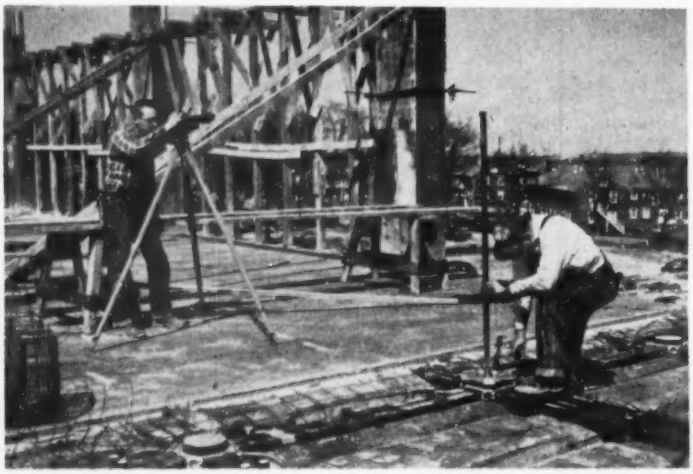
TOOL CHECK LIST

Benches, *large, small, wood, metal—stationary, rolling*
Benders, *pipe, tubing, hydraulic, mechanical, manual or power driven*
Block, *snatch*
Block and Tackle
Burners, *gas, acetylene*
Chains
Chalk, Chalk Lines, Crayons, Marking Materials
Crimping Tools
Dollies
Drills, *electric, hand*
Drills, *electric impact*
Drill Presses
Drivers, *stud, powder actuated*
Forge
Hacksaw, *hand, power driven*
Hickeys
Hammers, *ball peen, claw, plastic and rawhide faces*
Hammers, *electric, pneumatic*
Hoist, *chain, manual, power driven*
Jacks, *screw, hydraulic—manual and power driven*
Jigs and Frames for *assembling groups of fixtures and other equipment*
Levels, *carpenters, surveyors*
Lift Platforms, *scaffold, boom, tower—manual or power operated*
Nut Runners
Power Drive, *universal*
Power Drive Adapter for *use with ½-inch electric drill*
Pinch Bars
Plumb Bobs
Punches, *knockout, mechanical, hydraulic—all sizes with dies*
Punches, *Whitney, for steel*
Saws, *hack, band, knockout, skill, keyhole, masonry, carborundum, wheel—manual, power driven*
Scaffolds, *rigid, rolling, stationary, sectional, telescopic*
Screw Drivers, *hand, ratchet—manual, power driven*
Shears, *sheet metal, angle-iron—manual, power driven*
Sledges
Stock, *bolt, angle, channel, continuous channel framing*
Seals, *conduit*
Splicing Tools, *soldering equipment*
Taps and Tap Wrenches
Threaders, *conduit, pipe—hand, power operated*
Torches, *soldering, gas*
Tongs, *chain*
Vises, *pipe, machinist, power*
Welders, *stud*
Welding Equipment
Winches, *manual, power operated*
Wrenches, *pipe, socket, adjustable, Stilson S*

WOOD PLATFORM TEMPLATE aligns and holds four runs of feeder bus duct installed and connected at junction points before delivery of switchgear.

TARGET ROD used with surveyor's level in aligning height of underfloor junction boxes has criss-cross channel-iron base with four glass levels. Box is level when bubbles are centered.

STEEL CHANNEL UPRIGHTS hold outlet boxes rigidly in position on partition line in apartment projects. Channel was tack-welded to boxes and nailed to forms before concrete pour.



SURVEYOR'S LEVEL is used to align underfloor duct junction boxes with finish floor line on section of metal-pan deck before concrete pour. Entire deck section can be aligned in a short time with one setting of level. Instrument has effective radius of about eight times that of string or steel wire method.

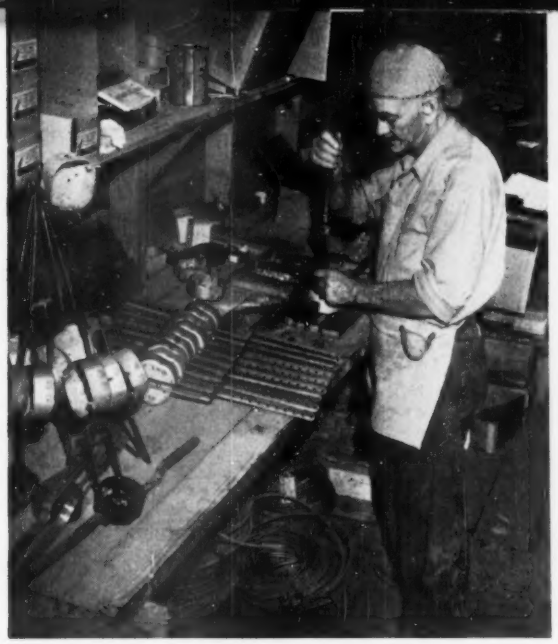
IT'S A CINCH to punch knockouts, large and small, in panel tubs with this hand-operated hydraulic unit. Contractor ordered panels without knockouts, found it cheaper to punch them out on job.

6,000 feet per day. The conduit was "kicked" into a shallow trench and sweep ells bent up at poll holes.

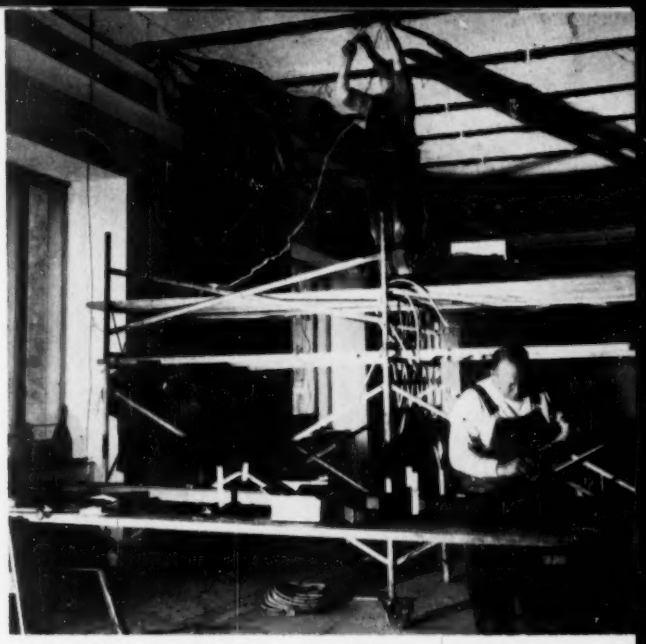
On another project where specially designed aluminum bus duct had to be fabricated and assembled on the job, the contractor set up a continuous-line assembly section under the catwalk where the duct was to be installed. Long sections of aluminum bus came in at one end, rolled along on conveyor rollers to an in-line band saw where it was cut to length. It then proceeded on conveyors to an in-line drill press and jig where a number of holes were drilled. From there it continued to an assembly bench where insulators were mounted, the bus assembled and enclosing covers added.

The extension of hydraulic operation to hand tools, such as the knockout punch, has led to extensive use of these items in the field. One construction superintendent admitted he ordered all panel boxes to be fabricated without stamped knockouts. He found it was easier—and less costly—with the hydraulic punch to cut knockouts as he went along on the job than to try to realign conduit stub-ups to fit factory stamped openings.

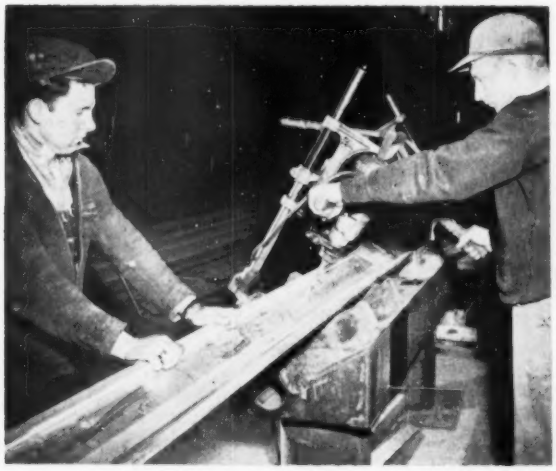
Surveyor's levels are becoming an important assembly tool for the electrical contractor. They are being used extensively for vertical alignment of underfloor duct to predetermined floor level. One instrument has an effective radius of about 400 feet compared to about a 50-foot limit



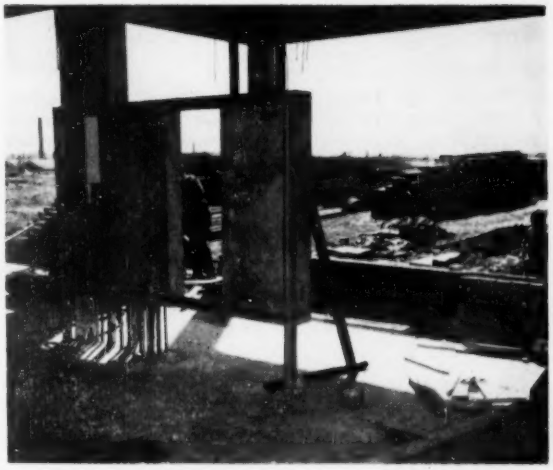
BRACKETS AND BOXES are assembled and grouped for housing development wiring project. Note use of bench jig and ratchet screwdriver. Prefabrication scheme slashed installation man-hours; roughing-in crew moved from house to house.



AT ASSEMBLY BENCH in foreground, fluorescent troffers are wired completely and equipped with flexible cable connection. Assembled units are then handed to scaffold crew who mount them to ceiling and make connections to circuit outlet box.



FIELD FABRICATION of special aluminum bus assembly required tilted drill press at one point along assembly line devised by the electrical contractor. Previously bus passed over conveyor rollers to metal cutting band saw. After drilling, insulators were installed.



STURDY WELDED FRAME of 3-inch channel-iron securely holds panel and conduit assembly at distribution point in office building project. Frame uprights and braces are embedded in concrete floor. Complete assembly will be enclosed when interior partitions are constructed.

with the string or steel wire method. On one job, a three-man crew (instrument man, rod man, and mechanic to adjust leveling screws) leveled some 2,400 feet of underfloor duct in about six hours.

These are but a few of the many actual field examples of assembly methods being effectively used by electrical contractors. Undoubtedly there are many more in practically every phase of electrical construction work. The number is increasing with each new project that is started, and with each new idea that is developed.

The contractor is not alone in his quest for new assembly ideas and techniques. Equipment manufacturers are backing him with improved product designs. Switches and controls are easier to install and service. Circuit breakers can be mounted and installed in less time than in the past. Panel enclosures have more wiring gutter space. Wiring terminals are easier to work with. Lighting fixtures have mounting and maintenance features aimed at cutting installation costs. The list could go on to include countless other items. The important point is that equipment and accessory designers have the contractor and maintenance man in mind. The products on the market today reflect that. The extent to which these products are to be used to replace the strictly manual methods of yesterday is a decision each individual contractor must make for himself.

NOTCHED ROD TEMPLATE is used to position conduit in hand bender on field shop assembly bench. Each notch represents a specified length of conduit stub-up after 90-degree bend is made. Mass fabrication of conduit in central location was part of systematized installation plan.

HAND OPERATED hydraulic bender is used on large aluminum conduit. Contractor preferred hand over power control of bender because aluminum did not have the "spring" of steel conduit to which mechanics were accustomed.

Conduit Work

FIELD fabrication and assembly of conduit raceways has become one of the most thoroughly mechanized of electrical construction operations. In the past, this classification of work was considered back-breaking and armtiring and assigned only to the most rugged mechanics. Today, power tooling has completely reversed this concept. Even hand stocks and dies have been "mechanized" by the use of the power vise. Conduit is cut, threaded and bent merely by a flip of a lever or push of a switch. Fatigue is no longer associated with this phase of an electrical installation. Man-hours expended become a function of a machine's capabilities rather than a function of a man's physical stamina.

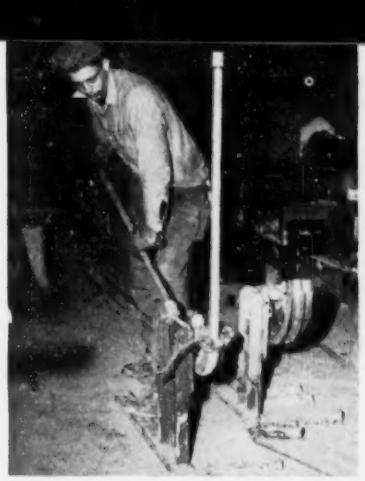
Conduit cutting methods range from the conventional hand hacksaw to the speedy metal cutting band saw. Hand methods are still used to a limited extent on small conduit and tubing—where one or two lengths are involved. Mass cutting of small conduit (in bundles or groups) in cases where measurements are identical is done with power equipment. Standard practice on housing and apartment projects is to cut, thread and fabricate duplicate conduit runs in the field shop, then distribute bundles of "made-up" assemblies to the deck for installation. For cutting large conduit, the band saw has almost universal acceptance in the trade; is about ten times faster than the reciprocating power hacksaw. On many projects, two three and four band saws will be found on the job.

Paralleling the advances made in cutting techniques is the progress achieved in threading methods. Now there are power units available for practically every threading operation and in price ranges to fit the tool budget of all contractors, large or small. Best known, perhaps are the variety of threading machines for small and large conduit and the portable threading units operated by a motor-driven "donkey" or universal power unit (power vise) which also can be used with hand stocks.

More recently, tool manufacturers have produced portable power operated threading units adaptable to small and large conduit operations. One unit popular with small contractors, whose operations may not warrant investment in the heavier equipment, is a light-weight kit containing a gear-drive threading unit which can be operated —through a special mandrel—by a standard ½-inch electric drill. Another portable threading unit in the same category has its own reversible motor and uses the worm and ring gear principle to turn popular die stocks on pipe up to

SMALL HYDRAULIC BENDERS, of 50-ton and 30-ton capacity, are mounted to wagon trucks in contractor's field shop. Benders are operated by motor-driven power units on separate mobile trucks; can be used anywhere that electricity is available.

MASS PRODUCTION of conduit bends was a one-man bench operation on this electrical construction project. Mechanic could control plunger travel with switch on motor-operated hydraulic unit with one hand, check offset measurements with other hand.



TWO PEDESTAL MOUNTED hand benders stand side by side in contractor's field shop; provide bending facilities for four different sizes of conduit. Small conduit bending operations were localized in one area of shop to speed operations.

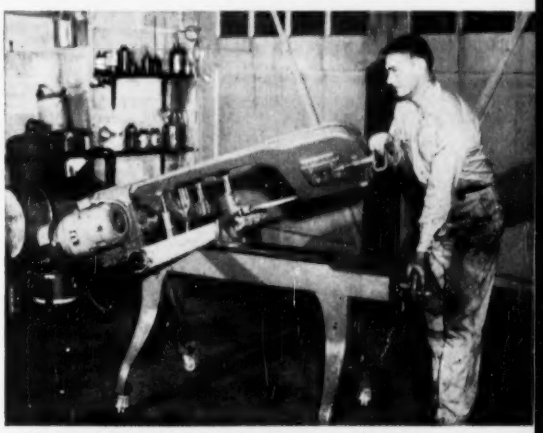
TOOL COST GUIDE

TOOL ITEM	COST PER MONTH*
Pipe Tools	
Large Benches	6
Small Benches	4
Vises—½" to 2"	12
Vises—2" to 4"	14
Stocks—¼" to 1½"	10
Stocks 2" ratchet	11
Stocks—2½" to 4"	12
Dies—½" through 2"	60
Dies—2½"-3"	30
Dies—4"	25
Power Driven Thread Cutter	7
Bender—small and large	6
Hickies—½"-1"	10
Thin Wall Bender—½"-1"	10
Wrenches—18"-24"	10
Chain Tongs—1½"-4"	10
Reamers—½"-3"	15
Oilers	33
Field Shop Tools	
Drill Press	5
Power Saw—universal band type	5
Copper Bender	4
Iron Bender—universal type	5
Electric Tool Grinder	6
Work Bench	6
Machinist Vise	4
Electric Welder	8
General Tools	
Steel Tool Boxes	5
Wood Tool Boxes	10
Ladder Chains and Locks	8
Step Ladders—6'-8'	20
Step Ladders—10'	22
Step Ladders—12'	28
Step Ladders—14'	32
Step Ladders—16'	33
Extension Ladders	10
Scaffolding Materials	20
Hand Tool Grinders	8
Electric Drills—¼"-½"	7
Twist Drills	25
Taps	60
Whitney Punches and Dies	6
Knock-Out Punch Sets	20

TOOL ITEM	COST PER MONTH*
Air Hammers	8
Electric Hammers	8
Reamers	15
Files	50
Star Drills	40
Hacksaw Blades	100
Bullpoints	25
Pinch Bars	20
Socket Wrenches	10
Bolt Stock and Die Set	25
Extension Cords	50
Burners and Tanks	5
Coffing Hoists	8
Chain Hoist—5-ton	4
Hemp Rope—½"-¾"	30
Snatch Blocks	5
Wagon Trucks	8
Dollies	10
Jacks—stone	4
Sledges and Hammers	15
Chain—coil	5
Cable Installation Tools	
Fish Tape—¼"-3/16"—100-ft.	50
Fish Tape—¼"—200-ft.	30
Winches—hand and power operated	7
Universal Power Drive	7
Wire Rope—¼"-⅜"—150-200-ft.	10
Cable Grips—"Come-Along"	15
Reel Jacks	6
Pick-Up Cart	8
Cable Brake	8
Payout Reels and Gang Type Reel Stands	4
Wire Strippers	8
Gas Furnaces	4
Electric Soldering Set	10
Steel Lettering Set	10
Special Portable Tools	
Floor Crane	5
Air Compressor	7
Electric Welder	8
Electric Flexible Shaft Grinder	8
Rolling Scaffold	10

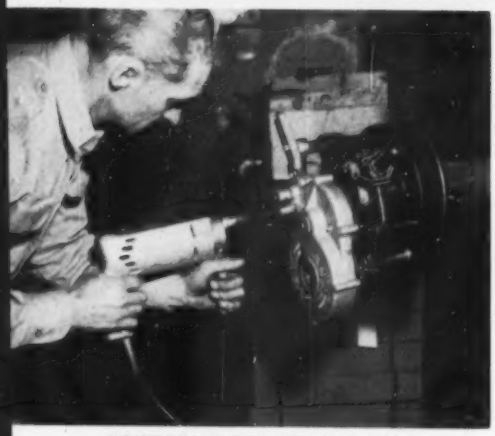
*Estimated cost per month percent of purchase price includes interest, depreciation, storage, repairs, obsolescence, etc.

Research data compiled by Ray Ashley, Research and Consulting Engineer, Chicago, Illinois.

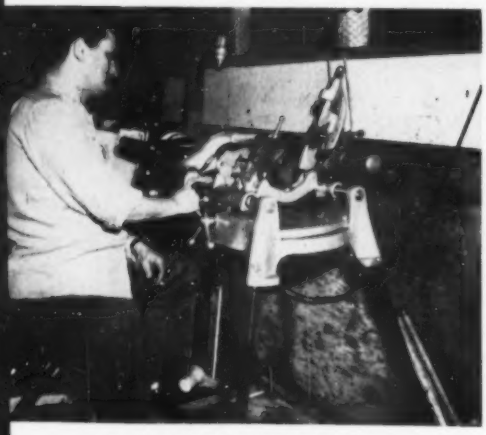


METAL-CUTTING BAND SAW cuts conduit up to 10 times faster than reciprocating type power hack saw; affects a substantial saving in installation man-hours. Unit can be set up in field shop or used on the job at actual installation areas.

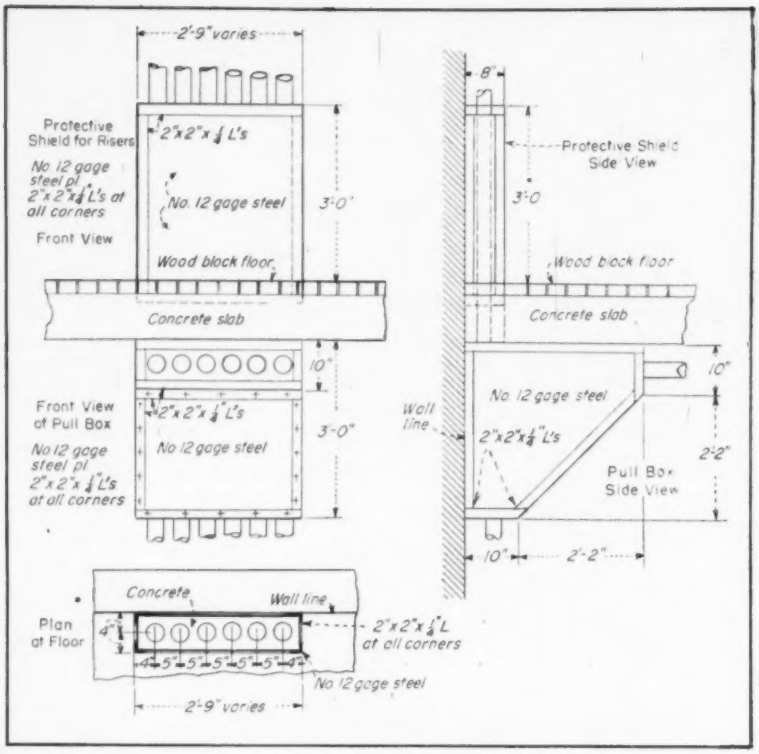
POWER VISE at left drives pipe threader (right) through universal connecting bar in contractor's "shop" in basement of building under construction. Length of 3½-in. conduit is held in bench vise. Hand stock and dies are used on conduit rotated by vise.



PORTABLE GEAR-DRIVE UNIT, makes possible the threading of 3½-inch conduit with a standard ½-inch electric drill. Unit (with 20 to 1 ratio) attaches to pipe threader. Special mandrel fits drill chuck and slotted collars on gear drive. Unit is reversible.



PIPE THREADING MACHINE in contractor's shop turns waste pieces of conduit into usable short nipples.



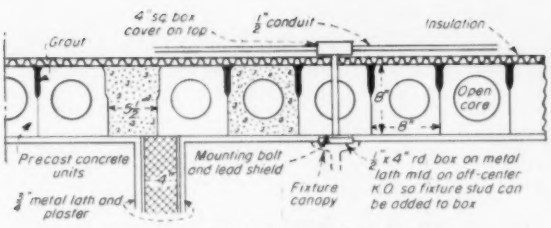
CONDUIT FEEDERS can be run in five directions with aid of ceiling pull box that fits juncture of ceiling and wall. Vertical risers go straight through; lateral branches can parallel wall on either side and enter box at right angles to wall. Screw cover gives access to interior.

TOOL CHECK LIST

Band Saws, *metal cutting, power operated*
Benders, *pipe and tubing, mechanical, hydraulic, manual and power driven, large and small*
Cutters, *conduit, tubing—hand and power operated*
Hacksaws,—*hand and power operated*
Hickeys
Power Drive, *universal for cutting, threading, reaming pipe*
Power Drive Adapter—*attachment to pipe threader powered by standard ½-inch electric drill*
Pushers, *pipe, hydraulic—manual and power driven*
Reamers, *pipe*
Stocks and Dies,—*various sizes*
Threader, pipe, *manual and power driven*
Threading Machines, *pipe, power driven*
Vises, *pipe, claw and chain*
Wrenches, *pipe, chain tongs, adjustable, Stilson*

4-inch diameter. Most unique feature of this 26-pound assembly is that it can be used to thread conduit in place, either overhead or in a trench, or in any limited space within five inches of a wall or where a 12-inch working area is available. Conduit threading is indeed becoming a faster, less complicated, much less arduous and safer operation. One enterprising contractor added limit switches to threading machines to prevent jamming or machine operation when chuck keys are still in place.

Conduit bending comes easier these days—if the proper equipment is used. Hand benders have new mechanical features which make conduit and tubing bending quicker and less strenuous. Even the conventional hickey has been redesigned to increase the variety of offsets which can be made. The addition of power pumps to hydraulic benders has transformed heavy conduit bending into a "watching" rather than a "pumping" operation. This observation was made on a large electrical construction project where a 100-ton power bender was in action. A two-man crew made nine 90-degree bends in 4-inch conduit in two hours, including setup time. Actual bending time per offset was less than one minute. Moving the conduit lengths into position, measuring for the bend and removing the conduit constituted the sum total of physical labor involved. The power unit, operated by an electric motor, had a limit switch control system which automatically stopped the ram at the proper distance to make the bend. Duplicate bends were all made with the same limit switch setting. The job superintendent on this project devised a handy wall chart



Section Through Ceiling One Story Structure

SHORT STUBS of conduit through concrete core slab ceiling connect ceiling outlet box to circuit conduits.

POWER VISE transforms hand cutting and threading into a mechanized operation. Mechanic merely holds stock or cutter handle against rest bar and lets machine do the work.

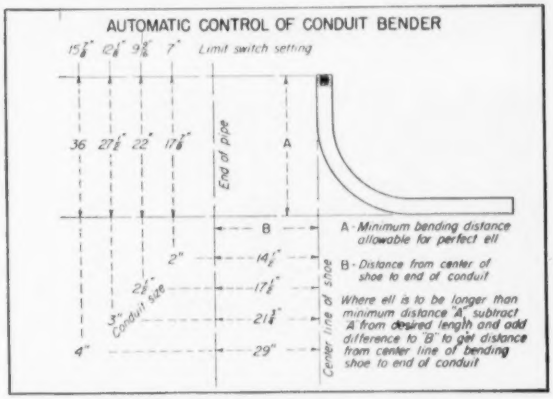
showing limit switch settings for different conduit sizes. This bit of ingenuity further slashed the setup time required in the operation. Coupled with the advantages of the motorized unit was the "one-shot" feature of the bending operation. Standard bending shoes are now designed to make the 90-degree ell in one long stroke of the ram in contrast to the multiple strokes and conduit shifts necessary in the past.

Not all benders need be equipped with integral power pumps. Portable pumps are available for use with standard hydraulic conduit benders. These pumps are powered by electric motors, where current is available, or small gasoline motors for field use where electric service has not yet been installed.

Availability of mechanized bending equipment has increased field fabrication of 90-degree bends in large conduit. Add to this the elimination of one or two additional conduit cuts and threads frequently required when manufactured ells are used and you have a significant cost savings.

Conduit system design will frequently have an effect on cable installation. Large, roomy, custom-built pull boxes will often cut cable pulling time and decrease the possibility of insulation damage. When and where to use what type of pull box, ell or conduit fitting will depend upon the length of conduit run and structural and job conditions. This phase of electrical construction work demands as much study and analysis as that of selecting proper tooling.

PORTABLE THREADING UNIT with integral motor uses worn and ring gear assembly to turn standard die stocks on conduit up to 4-inch diameter. Here, unit with square socket adapter turns regular geared die stock.


AUTOMATIC CONTROL OF CONDUIT BENDER
Limit switch setting
End of pipe
A - Minimum bending distance allowable for perfect ell
B - Distance from center of shoe to end of conduit
Where ell is to be longer than minimum distance "A", subtract "A" from desired length and add difference to "B" to get distance from center line of bending shoe to end of conduit
Center line of shoe
Conduit size
2"
3"
4"

LIMIT SWITCH CHART developed by project superintendent to show limit switch settings for automatic control of 100-ton, power operated hydraulic bender. Mechanic checks chart before setting ram limit switch for different diameters. Settings are for 90-degree bends.

HYDRAULIC HAND PUMP attachment makes bending of large size thin-wall tubing a quick, easy operation. Unit can be used on floor as shown or on assembly bench.

REEL HAND CART with welded conduit frame and large casters combines rapid transportation of multiple reels of circuit conductors with quick and easy pay-out features. Unit can be used on construction or maintenance work.

SPECIAL SHEAVE ASSEMBLY directs 3-conductor interlocked armor cable around two 90-degree bends during continuous 500-foot pull. Three 16-in. diameter aluminum sheaves are mounted in tandem in a flat, triangular frame.

REEL TRAILER attached to pick-up truck keeps cable reel clear of ground as conductor is fed into underground conduit on street lighting project. Trailer tips back to engage or disengage reel. After cable is fed both ways at this point, trailer will be moved to another set-up point.

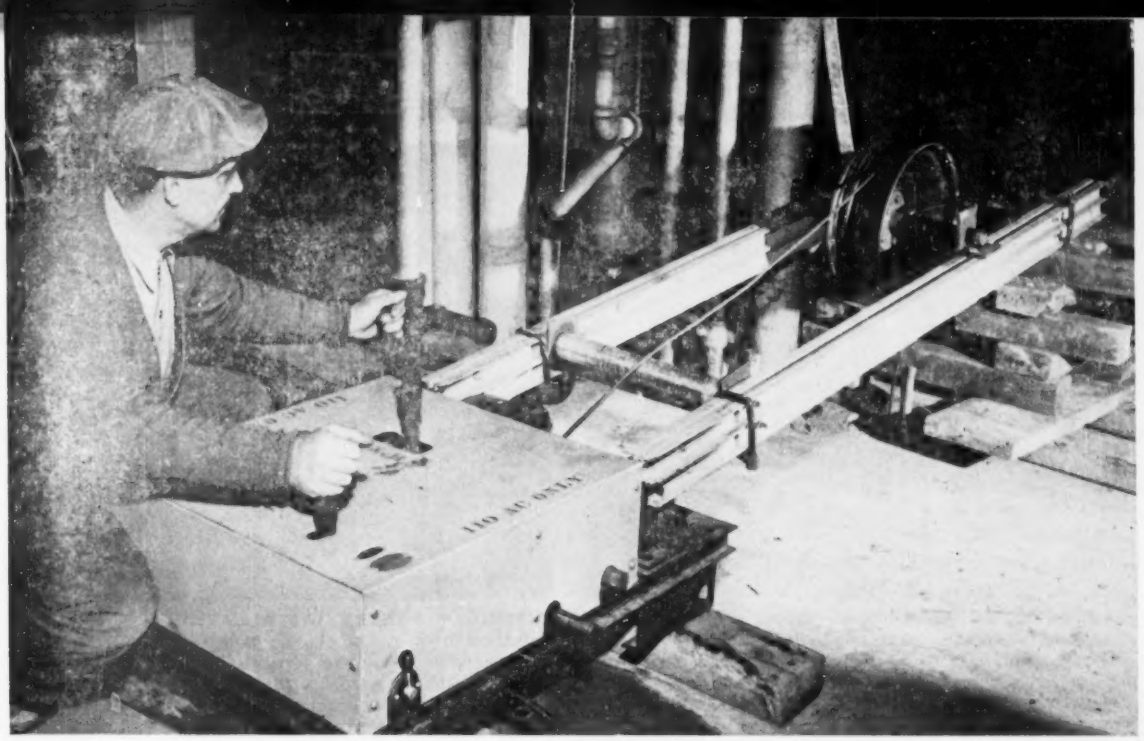
COMPRESSED AIR blows fish rope through 300 feet of 1-inch underground conduit in a matter of seconds, simultaneously swabs conduit. Rag in rope loop is stuffed in Y coupling into which special guide of Monel metal fits. Mechanic pays-out fish rope and operates the air valve.

Wire Handling

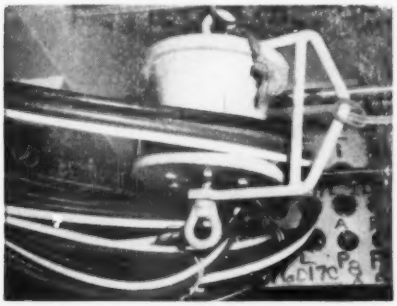
INSTALLATION of conductors and cables can be easy or difficult, simple or complicated, depending upon the technique employed and the type of equipment used. The major precaution, in any case, is to avoid damaging the insulation or protective sheath when pulling cable into a raceway. This applies whether conductors are installed in exposed or concealed conduit, ducts, wire troughs or in open air or insulating supports.

Choice of installation technique is usually controlled by a number of factors. Among these are: raceway system design; number, location and size of pull boxes; length of run, number and type of offsets; size, weight and number of cables; available working space for reel setup and winch equipment; and the limitations of the cable handling equipment on the job.

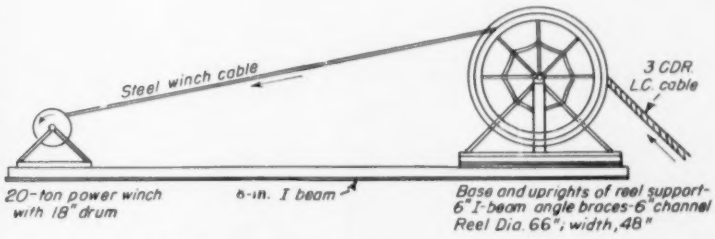
On the question of pulling in multiple-story riser cables, agreement is divided as to the most efficient method. Some contractors suggest placing cable reels on the top floor and winch equipment in the basement. Then cable weight and gravity will reduce the required pulling ten-



PORTABLE MOTORIZED WINCH with adjustable boom and pulley attachment pulls 310-foot run of four 350MCM feeders in 3½ inch conduit up 26 floors, through two ells and an offset, on an apartment construction job. Actual pulling time (excluding winch and cable reel setup in basement) was about 3 hours. One man operated two-speed winch (3 ft./min; 7½-ft./min); one man traveled between floors; two men guided the four cables at basement reel setup.



LARGE CABLE PULLEY suspended in right angle pull box permits continuous pull of 500MCM conductors around 90-degree bend; eliminates duplicate winch and feed-in operation. Hardwood pulley has wide, shallow face and steel end plates. Heavy steel yoke takes lateral pulling stress. Method solves problem of installing conductors over crowded floor.

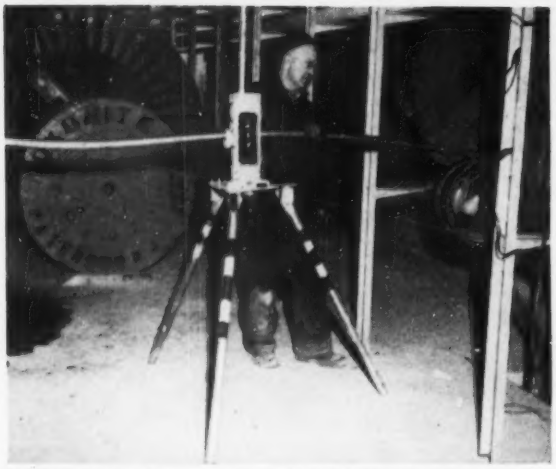

Steel winch cable
3 CDR LC cable
20-ton power winch with 18" drum
8-in. I beam
Base and uprights of reel support-6" I-beam angle braces-6" channel
Reel Dia. 66", width, 48"

CABLE SALVAGE REEL assembly designed by an electrical contractor to cut man-hours and reduce sheath damage when pulling lead-covered cable out of underground ducts. Steel cable reel is 48-inches wide and 66-inches in diameter. Side of reel has a 4" x 4" steel gutter around which some 600 feet of ½-inch flexible steel winch cable is wound. As steel cable winds around drum of 20-ton power winch, the cable reel rotates counterclockwise pulling 600 feet of 500MCM, 3-conductor lead sheathed cable out of duct and reeling it at 12 to 15 ft. per minute. Full reel can be rolled onto truck. Reel saddles and base frame knock down into sections for easy moving.

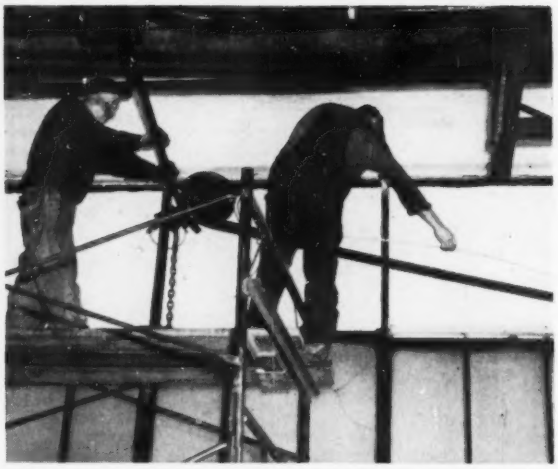
sion. Other contractors are reluctant to use this method, claiming that there is too much danger of the cables "running away" with resultant snagging and insulation damage. Those subscribing to the latter premise contend that an upward pull against cable weight is by far the easiest controlled and safest method. Often, it is more practical to move winch equipment to upper floors than heavy reels of conductors or cables.

There are a number of ways to pull horizontal runs. One is to feed the cables in at one end of the raceway and pull out at an intermediate pull box, then feed in again at this point and pull out at the panel terminal (end of run). This requires two winch setups plus the extra time and crew working at the pull box. Many contractors eliminate this extra expense by pulling straight through the box. Even at right angle pull boxes, one enterprising contractor pulled more than 20 feeders (each consisting of four 500MCM conductors) around the turn and through to the distribution panels in one operation. A large diameter, wide-face wooden cable pulley suspended in the pull box made this possible. On another project, 500-foot and 750-foot runs of interlocked armor cable were pulled on open racks around several 90 degree bends in both horizontal and vertical planes in a single operation. Special three-sheave assemblies guided the cable around the right-angle turns and detachable rollers on the racks reduced frictional resistance between cable and rack.

The secret (if there is one) to any successful cable

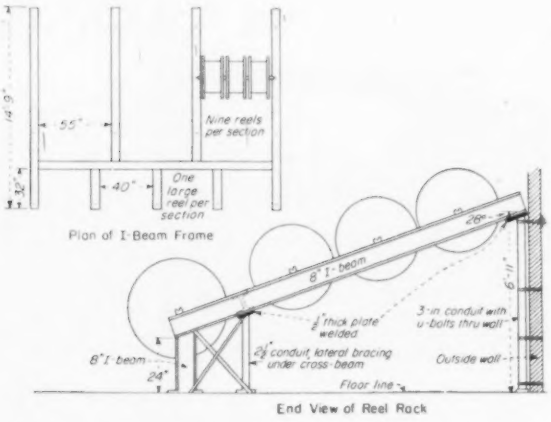


CABLE METER on collapsible tripod stand measures length of lead cable being pulled into underground conduits; minimizes cable waste; eliminates need to pull out and measure cable prior to pull. Meter readings are deducted from known length of cable on reel to show how much remains on reel.



DIFFICULT FEEDER INSTALLATION was solved by using cable sheave to change direction of pull after the three conductors passed through ceiling pull box. Cable winch was on Jeep truck at floor level and at right angle to feeder conduit. Mechanic at right measures length of conductors to be left to reach distribution panel.

HEAVY CABLE STORAGE and pay-out rack in shop of contractor located in an area where relatively short lengths may be needed in a hurry. Rack holds total of 31 reels, is made of 8-in. I-beam on 3-inch conduit uprights.

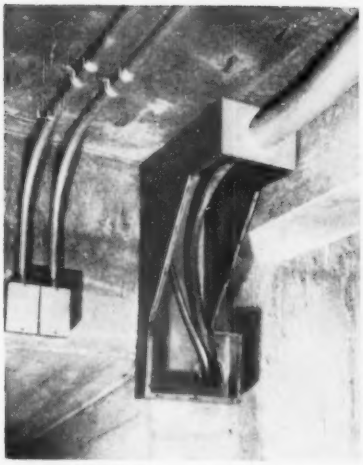


DETAILS OF I-BEAM rack constructed in contractor's shop to combine storage and easy pay-out of heavy cable. Rack holds 31 reels of varying diameters. Area underneath rack is used for other storage purposes.

installation is to secure and maintain a steady pulling tension to keep the cable moving at all times. This advantage is lost if the cable is pulled in "hitches". Each time a stop is made, the inertia of the cable dead-weight must be overcome. Careful payout of conductors at the conduit entrance (particularly in case of multiple-conductor feeders), application of proper cable lubricants and modern, high-capacity, winch equipment will generally permit continuous-pull operation.

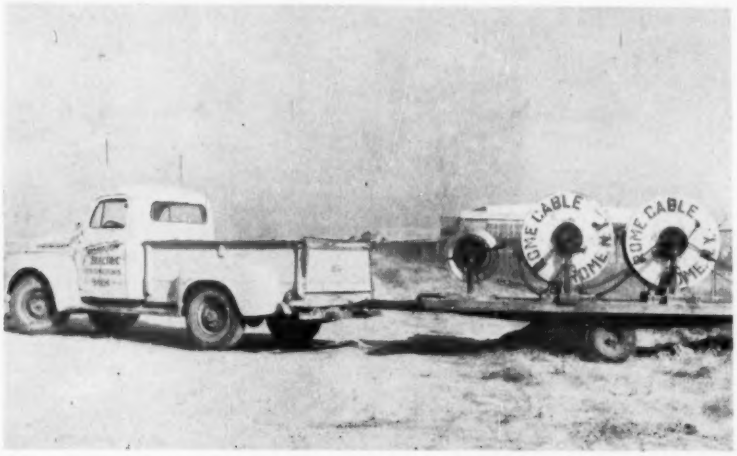
Winch equipment will vary with the size and type of job. It can range from the hand operated units which clamp on the conduit to motorized units driven either by conventional power units or built-in motors. On some projects, where working space is not at a premium, truck winches are most effective. Where electrical power is not available and trucks cannot be used, gasoline-powered winch assemblies do a good job. Next to capacity, greatest factor in choice of winch equipment is portability and setup ease—two items which can substantially affect installation man-hours. One unit quite popular with electrical contractors is a portable (has four detachable wheels) motorized winch with a two-speed drive and an adjustable boom and pulley attachment.

Considerable progress has been made in the art of fishing conduits and ducts. In many cases, the steel fish tape has been replaced by compressed air devices which blow a fish line through long conduit runs in a matter of seconds and swab the duct at the same time. On branch circuit work on one project, a contractor effectively eliminated the fish tape by devising a blunt-nosed metal cap which screwed on to two or three branch circuit conductors (much like a "wire net"). Conductors were then pushed



TRIPLE-OFFSET pull box overcomes beam obstruction, changes elevation and shifts from concealed to surface mounted raceway for cable run. Cable pulling problems can be simplified by judicious design and use of pull boxes.

REEL ON MECHANICAL JACK holds four 500MCM single conductors of different colored braid, cut and reeled to specified length at the factory. Cable ordered like this eliminates field setup of four reels, measuring and cutting.



MULTIPLE-REEL flat-bed trailer pays out cables into manhole on airport lighting project. Same trailer, pulled by standard pick-up truck was later guided along open cable trenching to permit underground cable to be payed out for direct earth burial.

TOOL CHECK LIST

Blocks, *snatch*
Block and Tackle
Brakes, *cable*
Cable Feeders
Cable Marking Labels
Conveyors, *roller type for pulling cable*
Compressors, *air*
Crimping Tools, *cable, wire*
Cutters, *wire, cable*
Grips, *wire and cable, basket mesh, comealongs*
Insulating Sleeves
Jacks, *screw, reel, gang, payout, manual, hydraulic*
Knives for stripping cable insulation
Measuring Machine, *wire, cable*
Pullers, *cable—mechanical, power driven*
Pulleys and Sheaves for cable and wire
Plow, *cable laying*
Reel Trailers, *carts*
Rope, *hemp, steel*
Rollers, *reel*
Rollers, *cable—for pulling cables on racks or in troughs*
Saws, *hack*
Solder
Soldering Pliers, *electric*
Soldering Devices, *chemical*
Solder Paste, Irons, Pot, Ladle
Splicing Tools, Kits, Compound
Strippers, *wire*
Tape, *fish, steel—manual and hydraulic*
Tape, *insulating, rubber, friction, lastic, varnished cambric, linen, cotton, asbestos*
Torches, *alcohol, gasoline, soldering, gas*
Welding Equipment
Winches, *hand and power driven*

through the conduit from outlet to outlet. On other jobs, the fish tape still works best. Choice of method depends upon the job conditions and system design at hand.

Cable handling is another factor which plays a large part in over-all installation costs. Normal practice is to carefully measure or estimate conductor lengths per conduit run and order cable cut to length and reeled at the factory. It is then delivered to the job site, either one conductor per reel or multiple conductors (of desired colors) on a single reel as specified by the contractor. Where this is not practical, as in short runs, conductors on standard reels can—if desired— be fed through a wire meter before entering the raceway and cut to exact length after the pull. This method was used on one project where lead-covered, multiple-conductor cables were involved. The meter recorded the exact length of cable installed in each conduit. These figures were progressively subtracted from the known quantity on the reel to indicate the amount of cable remaining. Where contractors are paid on a per-foot-of-cable-installed basis this method simplifies record maintenance and cost accounting.

Cable payout methods also vary with the job at hand. Mechanical and hydraulic reel jacks are normally used on exceptionally heavy reels or on projects where one or perhaps two reel setups will suffice. For medium and small reels, roller base frames with ramps work well.

Where reels must be moved, reel carts and trailers find extensive use. Designs vary from small multi-reel hand carts for branch circuit work to two- and four-wheel trailers accommodating one or more reels.

Regardless of technique used, the ultimate goal is a combination of speed, safety and wire handling ease.

HYDRAULIC CRANE with small clamshell scoop starts excavation for pipe pushing equipment to install 3-inch conduit under highway.

BORING UNDER HIGHWAY with a pneumatically operated auger to install 3-inch conduit. Drill hose leads to air compressor trailer. Auger was quicker than hydraulic pipe pusher because fill had high sand content.

MOTORIZED HYDRAULIC pipe pusher shoves 25 feet of 3-inch conduit under concrete highway in less than an hour, including setup, adjustment and coupling time. Gasoline driven hydraulic motor on truck bed requires only a flip of a lever to actuate pusher mechanism. Where truck cannot approach excavation, motor is demounted and dragged on steel skids. Pipe pusher and auger were both used on highway lighting installation.

Underground Work

Mechanization of field operations for installation of underground electrical systems involves a majority of the heaviest and most expensive (from an initial investment viewpoint) equipment in electrical construction work. Original cost should not, and with progressive operators does not, defer acquisition of mechanized equipment items. Initial operations in underground work, as the term implies, involve excavation and trenching. The man-hour differential between hand labor and machine operation is so great that even small contractors find it economical to rent trenching equipment for a single project or limited use on a number of jobs. Present trends toward underground service and subfeeder systems have led many contractors to purchase such equipment items. Realistic job-cost charges against individual project use result in a reasonable write-off period and the contractor is in a much better competitive position on future work.

The nature of underground electrical work is such that large trenching and excavating machines are not required. Much of the electrical contractor's excavating operations can be done with trenching attachments on jeep trucks. These jeep units have the power to cut clean swaths through most earth compositions; can average up to 100 feet of trench per hour and have the advantage of high-speed movement, under their own power, from job to job. Other small gasoline-operated trenching machines do a similar job and feature one-man operation.

Excavating for manholes and access holes for pipe pushers normally was a hand operation. To slash this time to a minimum, one midwest contractor uses a multi-

JEEP TRENCHER cuts 8-in. by 24-in. trench between sidewalk and curb for direct-burial street lighting cable. Unit makes up to 10 feet per minute when going is good. Chain scoop is raised to skip over sidewalks, then lowered to continue digging. Planks under jeep wheels protect lawns.

PNEUMATIC AUGER is used on street lighting project to bore under sidewalks and driveways for direct burial cable. Auger is 2-inch diameter with coupled sections totalling nine feet in length; works faster than pipe pusher for this specific type of work. Air drill connects to compressor.

MIDGET BULLDOZER backfills cable trench in a jiffy; does the work of 8 to 10 men with shovels, according to construction foreman. Unit is powered by small gasoline engine which operator straddles. Rubber treads were used for this residential street lighting project to prevent damage to sidewalks.

MULTI-PURPOSE TRACTOR used on underground electrical installation has air compressor to operate air drill with auger attachment for boring under sidewalks and driveways. Pneumatically-operated tractor boom has rotary head for attachment of pole-hole auger. Boom auger is used in tight places instead of truck-mounted auger.

WIRE SCREEN RIG mounted on rubber-tired wheels straddles cable trench after direct-burial cable was installed. Unit screens out stones and rocks in initial layer of backfill to prevent damage to cable insulation. Diverting trough behind screen directs dirt into trench. Workman in trench tamps stone-free earth around cable.

purpose hydraulically operated truck crane with a small clamshell scoop. Sizable holes are now dug in a matter of 10 to 15 minutes. When not used for digging, the crane truck is used for a number of heavy lifting chores.

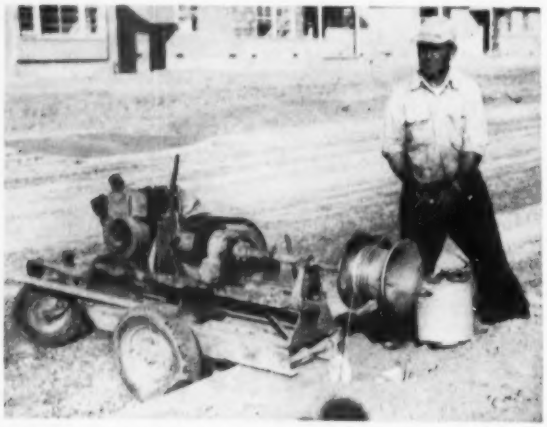
Backfilling is now a mechanized operation with bulldozers being used extensively. The increased use of direct-burial cables, however, makes this operation more critical than with conduit or concrete-encased duct installations. Stone and rock damage to direct-burial cables must be avoided. Among the methods of doing this are: use of creosoted planks over the cables; spreading of a protective bed and cover of clean sand under and over the conductors; screening of initial back fill to provide a rock-free cushion of earth.

A midget bulldozer, powered by a one-cylinder gasoline motor, solved the backfilling problem for a midwest contractor installing a street lighting system. Because the trenches were dug in lawn areas between sidewalks and curb, standard tractor units could not be used. The small unit, equipped with rubber treads, rode the sidewalks and accomplished the work of 8 to 10 men.

Where conduits must be installed under existing roadways or sidewalks, a hydraulic pipe pusher is usually the first equipment item considered. Quickest and easiest way to do this is to use a hydraulic power attachment operated by a gasoline motor and mounted either to one side of the excavation or on a truck bed. A long hose connection runs from the motor to the pusher in the trench.

It is not always possible to push conduits under roadways. Feasibility of using this method depends upon the composition of the roadbed fill. Sand is one material which usually defies pipe pushing operations. In such cases, compressed air rotary drills with auger attachments are used to tunnel under the concrete before installing the conduit. Air-augers are also used to advantage for tunneling relatively short distances under numerous sidewalks and driveways on street lighting projects. This applies to conduit or direct-burial cable installations. Size of excavation and amount of setup time required by hydraulic pipe pushers often rule out this method.

SMALL SELF-POWERED TRENCHER is becoming a favorite with electrical contractors. Light-weight unit is powered by gasoline motor, cuts trench 36-in. deep up to 6-in. in width. Overhead chute discharges dirt, soil plow clears edges of trench, adjustable scraper cleans bottom.



WINCH TRAILER has shaft extension which centers capstan drum over underground conduit stubups. Conventional cable drum is on shaft near gasoline motor which provides pulling power. By reversing hitch on capstan drum, mechanic pulls cable from opposite direction, making two pulls with one winch setup. Unit was used extensively on residential street lighting project where conduits ran from one lighting standard to the next.

PNEUMATIC FISHLINE propels flexible steel cable through underground conduits and ducts to manhole in a matter of minutes. Cable is connected to eyebolt and pulled back through duct during retrieving cycle while fish line is automatically rewound for next operation.

TRENCHING CASE STUDY—HAND VS. MACHINE

Project: An 800-car drive-in theater. Study made on 10,000 feet of a total of 24,000 feet of trenching required for electricity, gas, water, heating, sound and driveway curbings.

Machine Used: A small trencher (weight, 550 pounds) on four rubber-tired wheels, powered by a 6 hp. gasoline engine and operated by one man.

Soil Composition: A tight clay mixed with cleachy limestone.

Size of Trench: 10,000 lineal feet, 4½-in. wide, 24-in. deep.

Time and Cost Comparison

	Ft. per 8-hr. day	Total Time	Cost per Foot Labor and Expense
Machine Digging	800	12½ days	2½ cents
Hand Digging	50	200 days	20 cents

Data from: Holmes Electric Co., Tucumcari, New Mexico

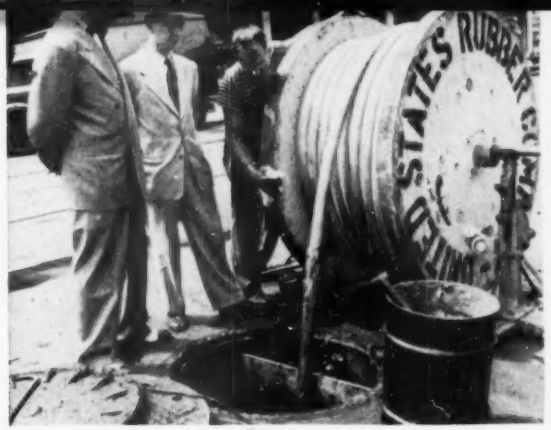
Well-equipped contractors actively engaged in underground electrical construction work make it a point to have an ample supply of both hydraulic and pneumatic tools. Air compressor trailers with accessories such as air hammers, soil tampers and other tool items have become standard field equipment. Pneumatic equipment for blowing fish lines through underground conduits, and even pulling in cables, cuts many man-hours from the labor column.

The trend to acquisition of multi-purpose equipment is continuing in the electrical field. One rather unique and exceptionally versatile tractor was used on a street lighting project. The gasoline-driven, four-wheel, rubber-tired unit is equipped with an air compressor and a pneumatically operated boom. In addition to normal pulling assignments, the tractor is used to operate air-augers for tunneling under sidewalks. A rotary head attachment (pneumatic) on the boom operates a pole-hole auger for use in limited spaces where truck-mounted augers are impractical.

Another example of this trend is the development of the cable plow designed to speed installation of direct-burial cables. The unit, combining trenching, cable laying and backfilling in a single operation, is used by a number of contractors for large-area installations where soil conditions permit.

Winch equipment for pulling in underground conductors is, with few exceptions, similar to that used on "inside" work.

One thing is apparent: mechanization is the key to operations of this type. Contractors like it. Mechanics like it. The owner, who pays the bills, likes it.



GOOD COATING of cable lubricant is spread on 3-conductor cable being pulled into underground duct. Lubricant reduces pulling tension (cuts resistance between sheath and duct walls) and helps protect cable sheath against possible abrasion or damage.

TRIPLE-TIER group of six concrete service ducts leave underground transformer vault, splay out to single elevation and are connected to steel conduits which enter large apartment building.

MECHANIC WIPES JOINT on lead sleeve, covering splice of direct-burial underground cable for street lighting project. Large excavation was made to permit ample room to work.

TRACTOR-TRENCHER cuts a clean 15-inch wide, 24-inch deep trench through wet and dry areas on an airport lighting project. Wide trench was used to provide ample space between three insulated conductors and one bare copper wire "counterpoise" added for lightning protection. Cables were laid on a 3-inch bed of sand and covered with another 3-inch protective layer of clean sand.

TOOL TEST LIST

Air Compressors, *gasoline driven*
Air Hammers, *drills and complement of air tools*
Augers, *various sizes and sectionalized lengths*
Bulldozers, *small, for backfilling trenches and excavations*
Benders, *pipe, hydraulic—hand, power operated*
Blocks, *snatch*
Block and Tackle
Braces, *trench, adjustable*
Bullpoints
Chains
Crowbars
Digging Machines, *clamshell scoop, trenching units*
Generators, *portable, gasoline driven*
Goggles, *safety*
Gloves, *safety*
Jacks, *screw, hydraulic—manual, power operated*
Levels, *carpenters, surveyors*
Picks
Pinch Bars
Plow, *cable laying*
Pulleys and Sheaves
Pushers, *pipe, hydraulic—manual or power driven*
Reel Trailers
Rope, *hemp, wire*
Saws, *wood, rip, crosscut, masonry*
Sledge Hammers
Shovels, *long and short handled*
Tape, *fish, steel, manual, pneumatic*
Torches, *gas, acetylene, cutting, welding*
Tongs, *chain*
Trenching Equipment, *conventional, Jeep attachment*
Trailers, *highway type for storing tools and materials, low-boy for hauling slow moving mechanized equipment.*
Trucks, *standard, heavy duty, winch*
Welding Equipment
Winches, *power operated*
Wrenches, *pipe, chain, adjustable, Stilson*

Line Construction Work

TELESCOPIC LADDER truck speeds pole line construction and maintenance work. Full complement of tools are carried in tool box. Spotlights on cab roof are used for night service work. One man can operate truck, position and adjust ladder and take care of pole-top work.

HYDRAULIC CRANE truck unloads 2,200-pound concrete light standards from pole trailer. Hydraulic outriggers on curb stabilize unit. Truck occupies only single highway lane while following trailer compared to cross-lane positioning required by line trucks with stationary rear boom.

LINE work is one phase of electrical construction that is almost an art in itself. Installation techniques are vastly different from those encountered in so-called "inside work". Materials are different too. Instead of handling conduits, fittings, pull boxes, motor controls, distribution panels, bus duct and cable troughs, the lineman installs poles, crossarms, pole hardware, guy wires, steel towers, pin and string insulators. The same is true of tools and equipment. Linemen have their pike poles, climbing spurs, shovels and spoons, pruning tools and sleeve wrenches, sag sighting T's, boom trucks and hole boring rigs—items normally foreign to the average electrical contractor.

Labor used on line work possesses different skills than that used on industrial or commercial projects. Because of this contrast, contractors extensively engaged in this work are specialists with engineering staffs and equipment geared to efficient, volume operation. A number of them operate on a national scope. Some of the firms who do both types of construction work operate the two as separate departments. Tools, men and equipment or material cannot be switched back and forth as is common when a contractor has only "inside" construction projects on his books.

There is, however, one common denominator in the two types of construction. That is the increased mechanization of field operations in the constant battle to cut installation man-hours. Pole holes are dug in a matter of minutes with truck mounted augers, poles are set with truck booms using half the crew needed for the hand piking method. More assembly work is being done on the ground. Crossarms, pole hardware, lighting brackets are installed at ground level. Transmission towers are being erected in sections instead of piece by piece, the sections having been assembled on the ground. Adjustable pole and crossarm hoists are used to raise distribution transformers to pole-top locations. Conductor payout carts and tractors for rough terrain are familiar field equipment items. Dynamometer dials assure proper conductor tension on long span installations. This is but a glimpse of mechanized progress in line work.

Probably the closest the average electrical contractor comes to actual line construction is on street and highway lighting projects, or limited intra-plant outdoor overhead distribution. Although conductors for most street lighting systems are now installed underground, line construction techniques are being used for the pole work. Lighting standards (concrete and metal) are now wired and assembled, including luminaire, on the ground. Combination boom and auger trucks drill the hole and set the assembled pole.

STAPLE PULLER is a very handy and efficient tool for a lineman. Unit is specifically designed to permit removal of staples from ground wire shield on pole.

SLEEVE WRENCHES are an important part of lineman's complement of hand tools. Used in pairs, wrenches permit mechanic to make secure splice of conductors at pole top.

ONE MAN CAN align a street lighting standard in less than 10 minutes with device designed by an electrical contractor. Pole is aligned when plumb bobs are equidistant from base.

RECOMMENDED POLE SETTING DEPTHS IN SOIL AND ROCK FOR VARIOUS LENGTHS OF WOOD POLES

Length of Pole in Feet	Setting Depth in Soil in Feet	Setting Depth in Rock in Feet
20	5	3
25	5	3.5
30	5.5	3.5
35	6	4
40	6	4
45	6.5	4.5
50	7	4.5
55	7	5
60	7.5	5
65	8	6
70	8	6
75	8.5	6
80	9	6.5

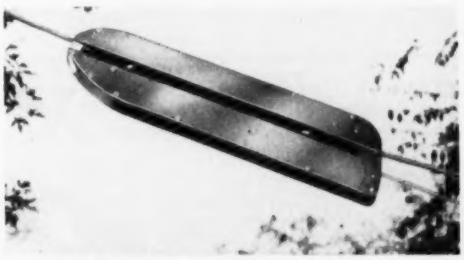
MAXIMUM RECOMMENDED TENSION AND SHEAVE DIAMETERS FOR DIFFERENT SIZES OF MANILA ROPE

Rope Size Inches	Min. Sheave Dia., Inches	Ultimate Strength, Pounds	Recommended Safe Loads, Lbs. (S.F.=7)
3/8	3	1,350	200
1/2	4	2,650	380
3/4	6	5,400	770
1	8	9,000	1,300

AVERAGE SIZE OF CREW REQUIRED TO RAISE POLES OF DIFFERENT LENGTHS BY PIKING METHOD

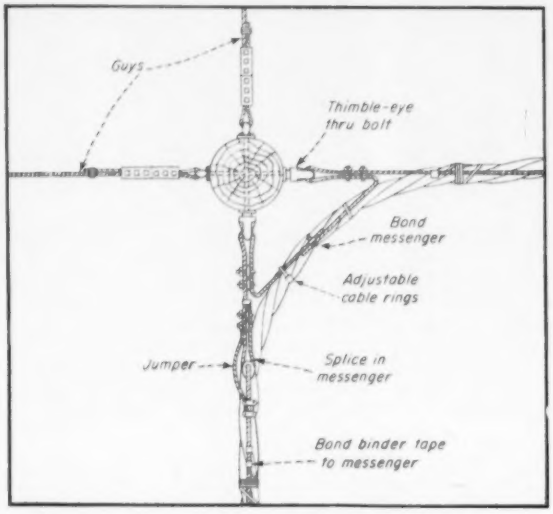
Pole Length in Feet	Size of Crew	No. of Pikers	No. of Jinnymen	No. of Men at Butt
25	5	3	1	1
30	6	4	1	1
35	7	5	1	1
40	8	6	1	1
45	10	8	1	1
50	10	8	1	1

From: Lineman's Handbook, 2nd Edition. McGraw-Hill Book Company

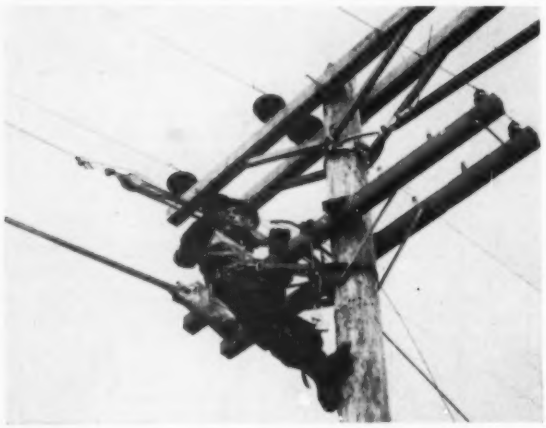


WIRE CREEPER SPEEDS stringing of additional wires through trees, over buildings and across ravines wherever one conductor is already in place. Creeper is attached to existing wire. As operator pulls and releases attached plastic cord, creeper moves in 10 to 20-foot leaps stringing attached conductor.

PRE-ASSEMBLED and wired 30-foot concrete lighting standard is set with line truck boom attachment. Men on guy ropes adjust tension with block and tackle to center standard over hole and for final aligning after tamping.



DETAIL OF messenger cable dead-ends on corner pole at right-angle turn in a run of aerial cable. Thimble-eye through-bolts support cable messenger on one side and guy wires on the other.



CABLE GRIP at end of block and tackle holds conductor securely while tension is applied to span. To prevent slippage, jaws of grip should be with benzol (or other solvent) and wire brush. Note insulating sleeve over bottom conductor to protect lineman on pole.

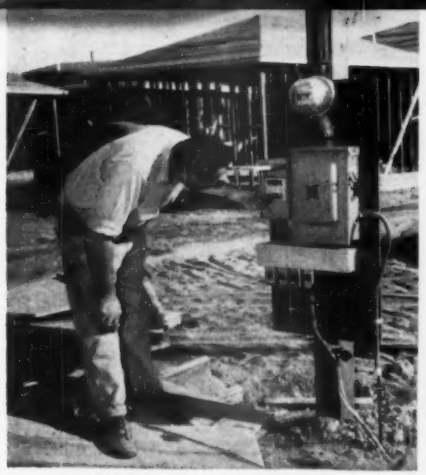
Many contractors improve upon established techniques. One midwestern firm used a hydraulic truck crane to reduce pole (30 foot, 2,200-pound, pre-stressed concrete standards) spotting and unloading time along a high speed superhighway. Because the crane could boom out over the shoulder it could follow the pole trailer closely along the curb line and thus tie up only the slow traffic lane. Conventional line trucks with stationary booms operated at right angles to the curb line, maneuvered back and forth to spot the pole, tied up two and three lanes of traffic and required extra flagmen to stop and direct traffic.

Other new ideas and improved methods are being devised with each new project to keep pace with electrical industry progress. The common goal is more safety, better workmanship, reduced installation time and lower overall costs.

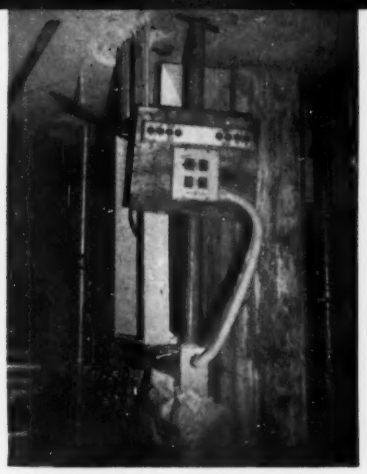
LINE TRUCK with auger attachment digs 6-foot pole hole in about 15 minutes. Boom assembly sets poles and standards. Truck carries full complement of line tools including long-handled shovels, spoons, pike poles, digging and tamping bars, ropes, block and tackle.

TOOL CHECK LIST

A-Frames
Augers and Diggers, *pole hole*
Augers, *pole hole, truck mounted*
Bars, *metal, tamping and digging*
Belts, *lineman's*
Blankets, *rubber*
Block and Tackle
Borers, *earth*
Buckets, *canvas tool*
Cant Hooks
Cars, *cable stringing*
Cutters, *wire and cable*
Derrick Trucks, *pole setting, digging*
Drills, *pole hole*
Drivers, *ground rod, guy anchor rod*
Flares, *lineman's*
Gin Poles
Gloves, *lineman's*
Gloves, *rubber*
Grips, *wire and cable*
Hoists, *pole top, adjustable transformer, ratchet lever*
Hand Lines
Jacks, *poles pulling*
Ladders, *aerial*
Live Line Safety Tools
Measurers, *pole*
Pile Poles
Pole Jenneys and Mules
Pruning Tools
Pulleys and Sheaves, *line wire stringing*
Pullers, *slack*
Reel Carts
Rope, *hemp, steel*
Saws, *power chain*
Shovels, *pole hole and spoons*
Splicing Tools
Spurs, *lineman's climbing*
Tension Indicator Dynamometer—*for pulling up line conductors*
Towers, *hydraulic*
Tractors
Trailers, *reel, pole, dollie*
Trucks, *line, service, ladder*
Wrenches, *assortment*



TEMPORARY POWER POLE at a housing project contains meter, master entrance switch, circuit breaker load-center panel protecting a series of 3-wire, grounded receptacles.



INCREASE IN SIZE of permanent riser conduit over specified diameter proved economical to contractor who did it to facilitate installation of temporary power feeders.

STANDARD EQUIPMENT on this electrical service truck is a small portable, gasoline-driven generator. Company is installing community master TV antenna system.

Temporary Power

EXTENSIVE use of power tools and equipment by all trades working on construction projects directs more attention to temporary power system design and installation. It's no longer a simple question of running a couple of "wash-line" circuits for lights and a few electric drills. Preceding pages reviewed the array of power tools used by electrical contractors in the course of their operations. Other trades use similar equipment, including electric welding. Many general contractors use electric winches, some with floor pilot light indicating systems, on concrete and material hoists. Intercom telephone systems between floors and field office on multi-story construction is common.

This phase of electrical work is becoming a substantial cost item, both initial and operating. Monthly power bills on some projects have been around $1,200. On others they were lower or higher, depending upon the size and complexity of the system. The point has been reached where temporary electric power is the key to efficient job mechanization. Systems of this type require careful engineering to provide adequate capacity and minimum voltage loss at the tool (see chart of conductor sizes for various circuit lengths for portable electric tools in section covering Installation and Fastening Techniques). Temporary power work should be treated as a separate item on electrical estimates and job cost sheets.

Normally, full responsibility for this type of service rests with the electrical contractor. Practically every specification contains a clause to that effect. Unfortunately, little, if any, indication is given as to the size of service or distribution circuits. The contractor must base his design on estimates of his own requirements, a liberal allowance for other trades, plus heavy power items such as material hoists.

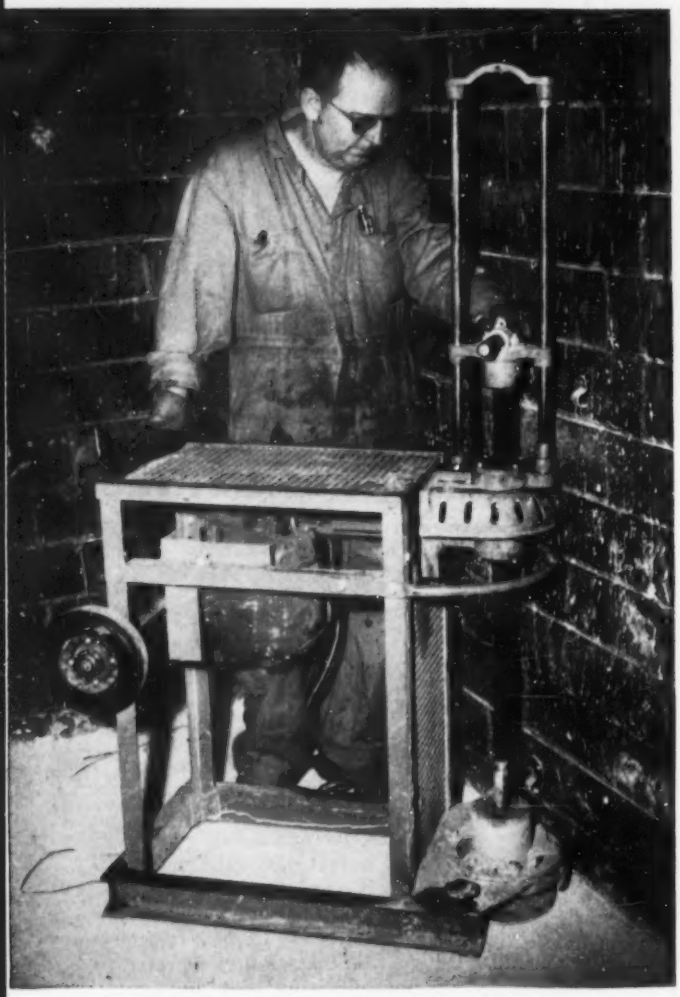
Regardless of size, application must be made to the local utility and electrical inspection authorities for temporary electrical service. Specific installation requirements may vary in different areas, but in general they follow those for permanent installation insofar as service equipment and materials are concerned. A service head, conduit drop, fused entrance switch and meter cabinet with adequate grounding facilities (usually a driven ground) are necessary. Beyond this, open wiring feeders and branch circuits can be used.

Job experience has proved that rubber-sheathed "pigtail" sockets can take a lot of punishment and are best for temporary circuits. This is especially true on long duration projects or jobs where wiring must be shifted at frequent intervals. Circuit conductors are generally standard building wire. Little, if any, of this material can be salvaged at the end of the job, hence it should be charged out as an expendable item.

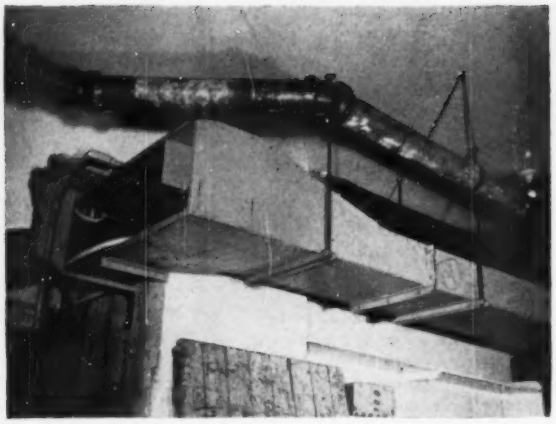
Distribution methods will vary. Standard practice is to string open wiring around a structure for both feeders and branch circuits. On one west coast project, however, the electrical contractor devised a safer and more economical method of carrying temporary electrical service throughout a multi-story building. He merely increased the size of a permanent spare riser conduit passing through pull boxes on all floors. He then pulled in four 250MCM cables and installed circuit-breaker load centers and grounded receptacles at each floor (state safety laws require grounding of all portable electrical equipment). On alternate floors he installed 100 or 200-ampere fused safety switches for heavy power needs. The additional cost of material and labor was charged to the temporary power item.

Portable gasoline-driven generators find ready application in the field for relatively small amounts of temporary power—particularly at the start of a project if utility service is not yet available. Or, they can be kept as a spare source of limited power if regular service is interrupted. Some contractors keep small units as standard service truck equipment. Others use larger units to power floodlights for night operations where necessary.

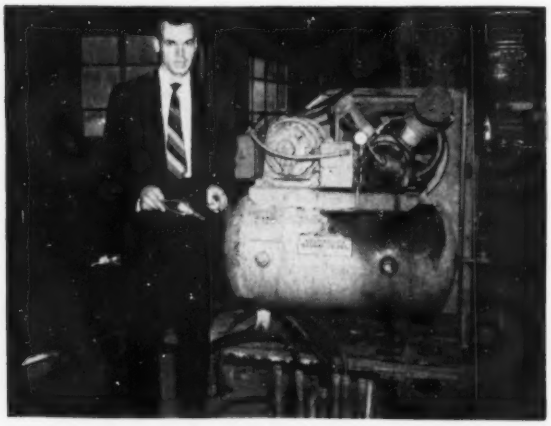
Maintenance of electric service during alteration projects logically falls in the temporary power category. Major problem is to keep equipment down-time to an absolute minimum while shifting circuits or installing new switchgear. Standard practice is to build a temporary switchboard on the job site using mounted disconnect switches.



HOLE BORING MACHINE makes cutting concrete slab for conduit risers a relatively quiet, quick, easy, one-man operation. V-belt drive on boring shaft absorbs considerable vibration and reduces noise level. Long, cylindrical boring tool cuts smooth accurate "plug" from slab. Machine can be tipped back on wheels for easy portability.



AWKWARD ENTRANCE of feeder cables to base of conduit riser shaft posed problem that was solved by contractor with design of a cable trough with flared-end, right-angle turn. Enclosed trough shifts from single to double-tier at shaft base.



PORTABLE AIR COMPRESSORS like this electric motor driven unit sometimes supplement electric power tools. In addition to making available a selection of masonry cutting accessories, a convenient source of compressed air is at hand for the assorted pneumatic tools often used on large electrical construction projects.

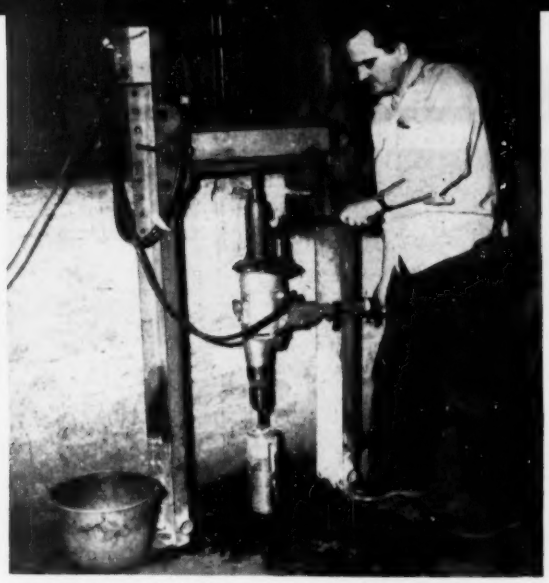
Alteration Work

ELECTRICAL system alteration or modernization presents one of the most formidable challenges an electrical contractor can face. Work of this type is seldom, if ever, as clear-cut as a new job with detailed plans and specifications and "clear sailing" with respect to installation. Existing structural design and job conditions, stringent space limitations, and meager, if any, information on original layout are but a few of the problems inherent in this type of project. And the frequent stipulation that the electrical work must be done while the building is occupied, or the plant is in operation, further complicates matters for the electrical estimator and project supervisor.

Alteration work stimulates the engineering imagination, frequently taxes to the utmost the technical talent, installation know-how and construction experience of a contractor's staff. Projects in this category can be profitable or unprofitable, depending on how the work is organized and handled. Answers to most of the questions and problems which arise come from that vast file labeled "experience"; not from textbooks. Unless installation labor is controlled through adequate power tooling and modern installation methods, man-hours can skyrocket more quickly than on any other type of electrical project.

Most alteration projects involve a substantial amount of cutting and patching, especially on the multi-story commercial type building. This is one operation on which power cutting and drilling tools can be used to greatest

SMALL HOLE BORING machine was used for circuit extension work in an industrial plant. Unit cut smooth holes in concrete floor; permitted alteration work to go on during normal working hours. Concrete core projects up into cylindrical cutting tool.



HYDRAULIC JIG designed by an electrical contractor to apply steady pressure on core drill when drilling concrete and masonry. Mechanic steadies drill handle against upright, pumps jack handle to apply pressure to core drill. Unit can be laid on its side for horizontal drilling.

MOTOR-DRIVEN CONCRETE SAW slashes time required to cut opening in a plant floor. Unit uses diamond blade, with a non-binding suspension, has a positive screw feed, adjustable depth lock and water spray control. Case study on a 2-hp. model indicated a sawing rate of about one lineal foot per minute, 1-inch deep.

FOUR-TIER TROUGH of vertical design was a contractor's solution to an obstacle-ridden, multiple-conduit installation in the engine room of an existing commercial building. Trough carries some 96 350 and 500MCM feeder cables from main distribution cubicles to an area where conduit mounting facilities were more adequate.

advantage. Choice of tool is governed by the specific work to be done and the location of the cutting operation.

For example, one hotel rewiring project required the cutting of hundreds of holes in concrete floor slabs without disturbing the hotel guests. A similar situation occurred in an office building job where installation proceeded while tenants worked in their respective offices. In each case, noise was the controlling factor. Because of this, air or electric hammers were definitely ruled out. Hole boring machines were used on the hotel job. After experimenting with numerous drilling methods, the contractor on the office building used diamond core drills (with water swivel attachment) in a drill press rig. Both methods used a V-belt motor drive. Project supervisors claimed this substantially reduced drilling noise since the V-belts absorbed much of the vibration instead of transmitting it to the drill rig.

Popular with electrical contractors and maintenance supervisors are the variety of masonry drills available which can be used with the standard electric drill; also those for use with hammers and impact tools (where such can be used). These range from small carbide tipped drills to large diameter hollow core drills with multiple tungsten carbide cutters—or industrial diamonds—set in the perimeter of the tube. Hole drilling time can vary from 2 to 10 minutes per opening depending upon size of hole, depth of slab and composition of masonry construction. Regardless of the specific type of masonry drill used, adequate power, pressure, proper drill speed and cutting lubricant (usually water) are important to efficient cutting. When using these drills keep in mind the principle of the lever and jack to devise pressure application methods. To cut drilling time and reduce mechanic fatigue, one enterprising contractor devised an H-shaped drill rig with adjustable cross-bar which suspended a small hydraulic jack fastened to an electric

ELECTRIC HAMMER with chisel attachment makes short work of channeling a plaster wall for installation of a concealed circuit switch leg. Mechanized equipment of this type can be applied to all types of channeling.

RECOMMENDED SPEEDS AND PRESSURES FOR DRILLING CONCRETE WITH CORE DRILLS

DRILL DIA. IN INCHES	ELECTRIC DRILL SIZE	DRILL SPEED IN RPM	SUGGESTED APPLIED PRESSURE IN POUNDS
3/16" to 7/16"	¼" or ½" medium or heavy duty	500 to 750	100 to 200
½" to 1"	½" medium or heavy duty	300 to 500	150 to 500
1" to 1⅞"	½" or ¾" medium or heavy duty	200 to 500	250 to 1,000
2" to 2½"	¾" heavy duty	100 to 300	500 to 1,500
2½" to 4"	1" or 1¼" heavy duty or equivalent rotary air motor	100 to 300	500 to 1,500
4" to 5"	1¼" heavy duty; 1¼" or large rotary air motor	Under 100 (around 80 rpm)	750 to 1,750
5¼" thru 6½"	1¼" heavy duty; 2" rotary air or larger	Under 100 (around 80 rpm)	1,000 to 2,000

NOTE: If possible, apply pressure with lever or jack mechanism
Data from Tilden Tool Manufacturing Company

TOOL CHECK LIST

Benches, *work, stationary, rolling*
Benders, *conduit, tubing, bus, mechanical, hydraulic, manual or power operated*
Block and Tackle
Boxes, *tool and material storage, stationary or rolling*
Bullpoints
Burners, *gas, acetylene*
Cable Marking Labels
Cable Jumpers—*to maintain service during alterations*
Cutters, *cable, conduit, tubing, knockout, manual or power operated*
Compressors, *air*
Cords, *extension*
Crimping Tools, *tubing, connector*
Dollies
Drills, *electric, impact, pneumatic*
Drills, *wood, steel, concrete*
Drivers, *stud, powder actuated*
Electric Welders, *stud*
Goggles, *safety*
Gloves, *safety*
Hammers, *manual, electric, pneumatic*
Ladders, *A, step, rigid, extension*
Platforms, *extension, lift, hydraulic*
Saws, *wood, concrete, metal and hole cutting*
Screw Drivers, *hand, ratchet*
Screws and Bolts, *assortment*
Scaffolds, *adjustable, rigid, rolling, stationary, sectional, telescopic*
Stock, *bolt, angle, channel, continuous channel framing*
Threaders, *conduit, bolt, hand, power operated*
Towers, *rolling, hydraulic lift type with platform*
Torches
Welding Equipment
Wrenches, *assortment suitable to work at hand*

NOTE: Choice of tools for alteration work depends upon the type of electrical construction involved: conduit, underground, or overhead, line work, etc. For additional tools in these categories see following Tool Check Lists: Material Handling, page 80; Assembly Techniques, page 83; Conduit Work, page 88; Wire Handling, page 93; Underground Work, page 97; Line Construction, page 100.

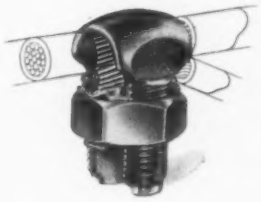
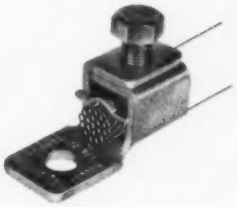
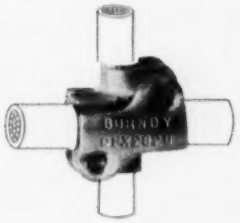
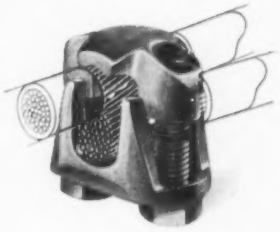
drill housing. The mechanic merely pumped the jack handle to apply sufficient pressure during the drilling operation.

Among recent advances in cutting techniques are the development of motorized circular saws, single or dual blade, which cut or channel plaster and concrete in a matter of minutes compared to hours by former methods. These units are finding increased acceptance among electrical contractors, particularly those who must do a substantial amount of channeling in the course of their normal operations.

These are a few of the "special" power tools available to slash man-hours on alteration projects. They represent only a small percentage of the job tool inventory. Hydraulic pipe benders, knockout punches, power saws, fastening tools, cable installation equipment, welders, scaffolding and many of the other items discussed in other sections of this review are also necessary.

Although power tools are responsible for a good percentage of the man-hours saved in electrical construction, contractor know-how and "installation engineering" talent have a very definite impact on over-all project efficiency. On alteration projects, electrical systems must be tailored to fit building design. Frequently, a carefully designed offset pull box can bypass a structural "block" to a conduit run. Or, the use of cable troughs can simplify what originally appeared to be an almost impossible raceway installation problem. Some of the photographs effectively illustrate these points. All are photographic records of actual field operations.

for CONNECTORS...

 SERVIT	 SCRULUG	 VERSITAP
 OKLIP	QIKLUG	HYLUG

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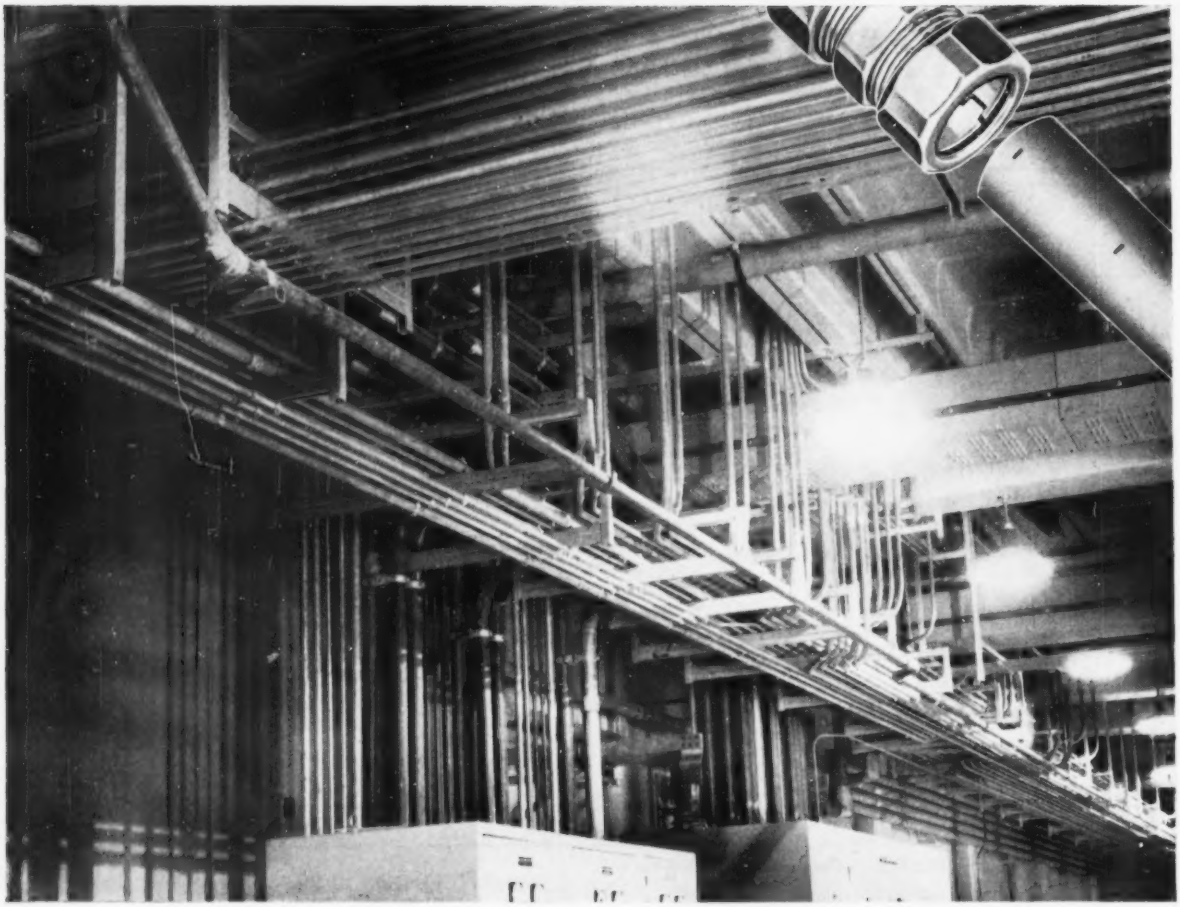

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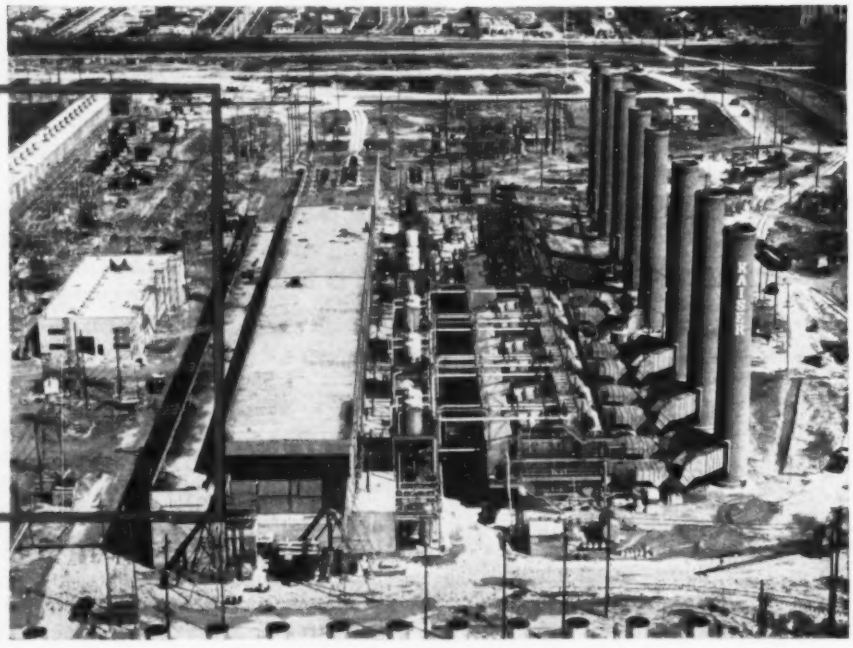
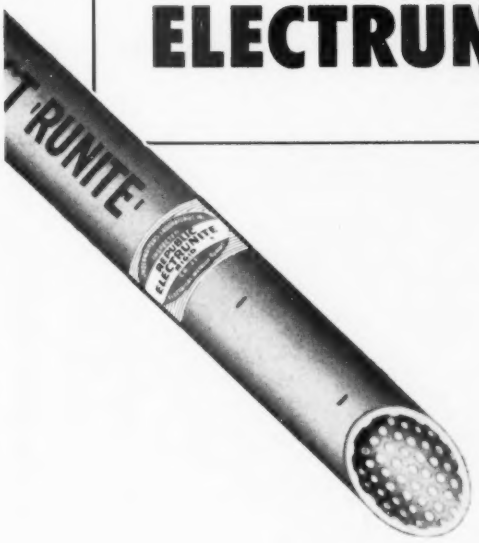


Power facilities of the new Kaiser Aluminum & Chemical Corporation plant in Chalmette, La., which was designed and built by Kaiser engineers, will generate 478,000 kilowatts. This volume is equal to almost half the installed capacity of Hoover Dam, the world's highest.

New Kaiser Aluminum Plant Uses ELECTRUNITE E.M.T.



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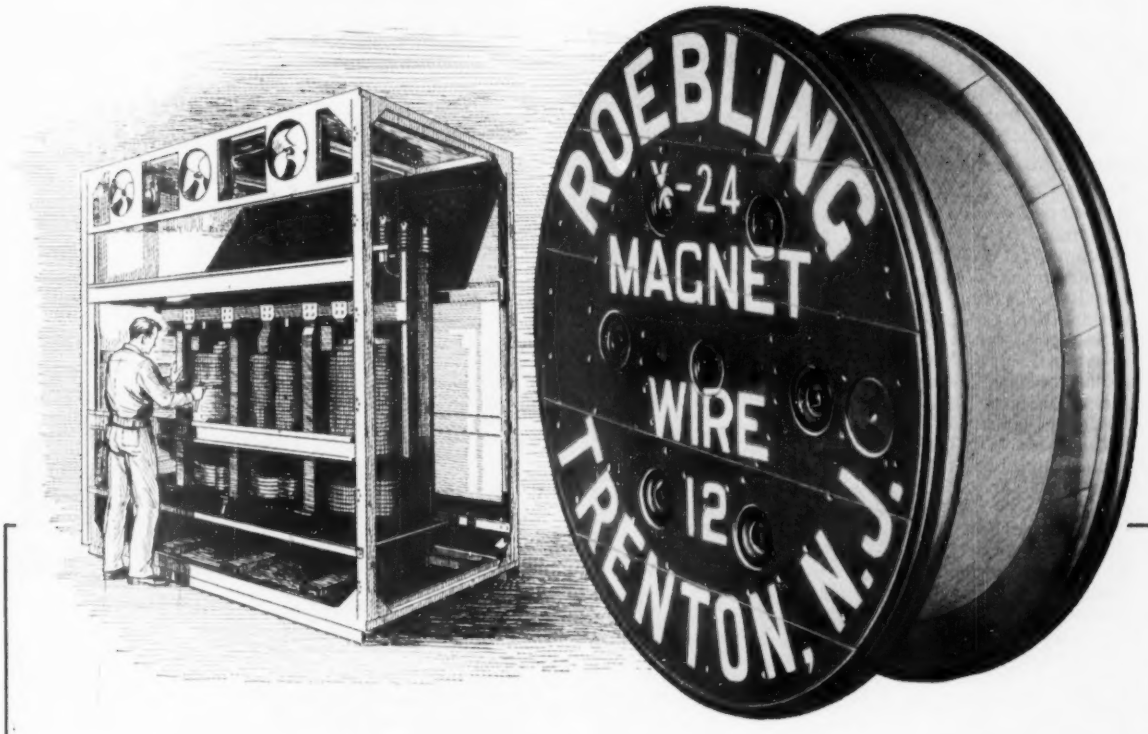

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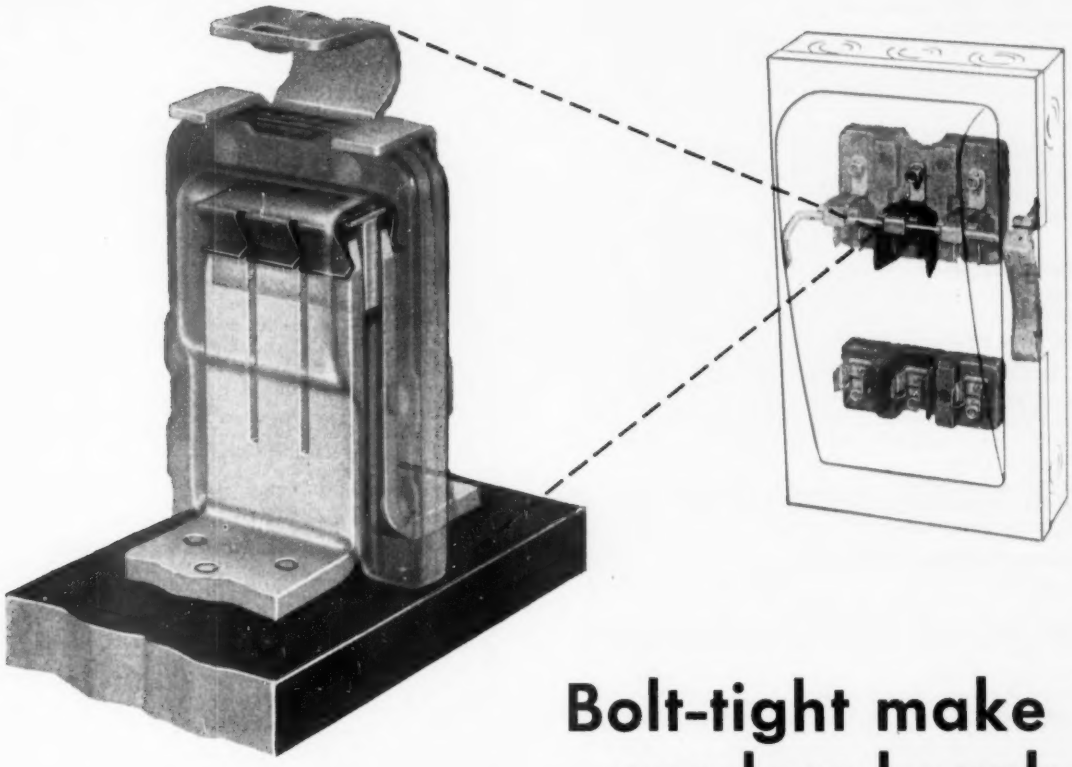
BULLDOG VACU-BREAK SAFETY SWITCHES



Each contact operates in a sealed chamber that excludes combustible amounts of oxygen from contacts. Piston-like action when rupturing circuit causes partial vacuum that further inhibits arcing. Clampmatic contacts give three times normal pressure on *both* sides of stationary contacts.

Bolt-tight make —arc-less break

Two exclusive BullDog safety features—the Vacu-Break arcing chamber and Clampmatic Contacts—bring you matchless safety switch economy as well as unequaled protection.

The Vacu-Break Chamber smothers dangerous arcs before they can burn or pit the contacts or build up dangerous temperatures. Protected contacts mean better operating, longer-lived safety switches for you.

The Clampmatic Contacts ensure positive, bolt-tight connections between contacts. The result to you is a cooler operating switch with a minimum of fuse failures.

BullDog's simplified line of thoroughbred Vacu-Break Switches handles *all* requirements. Write today for free Bulletin SS-250 containing complete information. Bull-Dog Electric Products Company, Dept. **EC73,** Detroit 32, Michigan.

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THOROUGHBRED IN ELECTRICAL EQUIPMENT

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ELECTRIC PRODUCTS COMPANY

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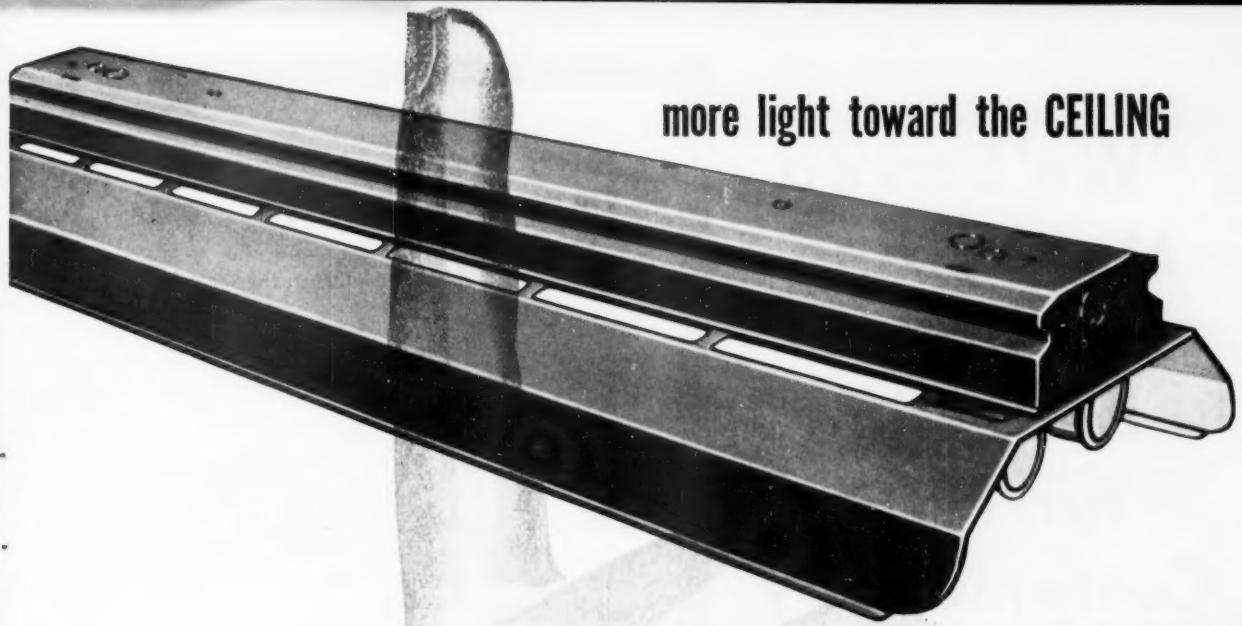


more light toward the CEILING

means more seeing comfort BELOW!

• • • new Benjamin Diffuser-Reflector now delivers almost TWICE THE UPWARD LIGHT!

- **increases brightness control for greater uniformity of light**
- **eliminates annoying shadows that distract from work**
- **reduces contrasts that can cause eye fatigue**

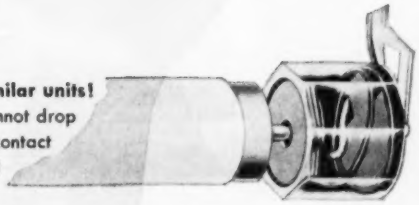
This improved, all-porcelain-enamel Benjamin Diffuser Reflector enables you to utilize highest light levels and still enjoy comfortable seeing conditions, without materially reducing lighting efficiency.

The answer lies in a series of 14 apertures, located on the top of the reflector, 7 above each lamp. Together, they direct 12.6%* of the light toward the ceiling. This greater upward light helps relieve disturbing contrasts between upper and lower room areas. It wraps the entire room in *uniform illumination*, so important in reducing eye strain and fatigue caused by excessive brightness contrast. For further details and lighting data, send for Data Bulletin. Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.

**for 2-lamp units. 10.7% for 3-lamp units. As compared with 6.7% and 5.9% respectively, delivered by previous Benjamin diffuser-reflectors.*

. . . and of course, it has "SPRINGLOX," the exclusive, metal-clad lampholder!

distinguishes Benjamin Diffuser-Reflector from all similar units! cuts out-of-service time due to socket failure . . . lamps cannot drop out or be shaken loose . . . never fails to make electrical contact the *first* time . . . patented spring construction is the secret!



BENJAMIN TRADE MARK

Diffuser-Reflector

Sold exclusively through electrical distributors

available in open-end and closed-end units, for single or bi-pin lamps.

a product of Benjamin Electric Mfg. Co., makers of famous Benjamin and Leader Line lighting equipment and Sound Signals for Industry, Institutions and Commerce

B-260

"We Saved Money and got better Protection for TWO Customers by switching to FUSETRON *dual-element* FUSES"

"Fusetron Fuses made it possible to use smaller size switch."

"Early this year I had the opportunity to lay out a wiring job for the Nehi Bottling Works at Boise, Idaho.

"After figuring the job with ordinary fuses it was found necessary to use a 400 ampere 250 volt main switch to carry the load.

"The proprietor of the bottling works felt that the cost was too great. I, therefore, refigured the job with Fusetron fuses and I found that I could use a 200 ampere 250 volt switch which besides being less expensive would result in better protection.

"Needless to say the proprietor was happier with the lower cost and I received the electrical contract."

Start Saving

FUSETRON dual-element FUSES do more than protect against short-circuits —they give 10 POINT PROTECTION

1 Protect against short-circuits.*

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money—permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December, 1947.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

"Heating in a main switch was causing fuses to blow until a Wholesaler's Salesman showed us how to cure the trouble with FUSETRON dual-element Fuses."

"During 1948 I was confronted with a bad heating problem in a 600 ampere 250 volt switch at Falk's Department Store, Boise, Idaho.

"When we checked the load on the switch we found that only 380 amperes were flowing. Even with this load the ordinary fuses used would melt and open every 30 to 90 days.

"The result of these fuse blows was confusion and annoyance to both customers and employees.

"At the suggestion of a local wholesaler's salesman 600 ampere 250 volt Fusetron dual-element Fuses were installed.

"The heating in the switch stopped immediately and we have not had that type of trouble since."

R. M. Alloway
Alloway Electric Co.,
Boise, Idaho.

One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse now!

FOR INFORMATION, MAIL THIS COUPON TODAY . .

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ ECM 7-53

with Fusetron Fuses

Motor Shops

Complete Data and Stock Insures Exact Coil Reproduction

14,000 TYPES OF COIL FORMS insure the exact reproduction of a coil being duplicated by the Pennsylvania Electric Coil Corporation. Needed wire, insulation and the like is listed, withdrawn from stock, subtracted from inventory cards.

One of the finest independent motor repair shops in the country—the Pennsylvania Electric Coil Corporation of Pittsburgh—can guarantee exact reproduction of damaged coils because their file system contains all data on all coils for all motors made in America. Their stock room contains forms and molds for over 14,000 types of field, armature and stator coils, and their inventory of raw material includes all varieties of wire and insulation. In addition to these physical requirements however, the company insures their accuracy of reproduction by frequent cross-checks with file cards, by using a comprehensive coil specification sheet, and by training their employees to devote unusual attention to detail.

When a sample coil is received, it is carefully stripped and all data (such as number of turns, dimensions, shape,

FORM 188

PENNSYLVANIA ELECTRIC COIL CORP				FIELD COIL SPECIFICATION NO.					COPY FOR DEPT
MAKE	H.P		R.P.M.	VOLTS		CAT. NO.			
TYPE	MFGR'S CAT. NO.			KIND		NO. PER SET			DATE
FORM	NO.			SH. SER COMP MOTOR		CUST.			SIGN
WIRE:	PAR	LBS.		COIL WOUND IN SHELL:					
WIRE:	PAR	LBS.		INS. SHELL:					
WIRE:	PAR	LBS.							
TURNS: SHUNT	OHM			INS. BETWEEN SECTIONS:					
TURNS: SERIES-INT.	NO. SECTIONS								
TURNS: PER SECTION				INS. BETWEEN SHUNT AND SERIES					
BLOCK SIZE: WIDTH	LENGTH	H	R						
BARE COIL "	"	"	"	OUTSIDE INS: WINDER					
SHELL SIZE "	"	"	"						
START WINDING				OUTSIDE INS: TAPER-ALL TAPE TO BE HALF-LAPPED					
INS. BETWEEN TURNS LAYERS				CLASS					
INS. ON CROSSOVERS				VARNISH					
LEADS CROSSED: SHUNT	SERIES	INT		COTTON					
LEADS: SHUNT	LENGTH			WEBBING					
LEADS: SERIES-INT	LENGTH			MICA					
TERMINAL NO.	CLIPS NO.			ASBESTOS					
ATTACH LEADS - TERMINAL				GLASS					
				FLEX MICA					
				PCS ROPE	DIA	LENGTH			
				OUTSIDE BAND WIRE:		WIDTH			
				INS. UNDER BAND					
INS. UNDER LEADS - TERM									
				TREATMENT: WHEN WINDING					
INS: OVER LEADS - TERM									
				BEFORE TAPING					
ENG. REFERENCE									
				AFTER TAPING					
POLE PIECE: WIDTH	LENGTH	H	R	WEIGHT OF FINISHED COIL					OVER

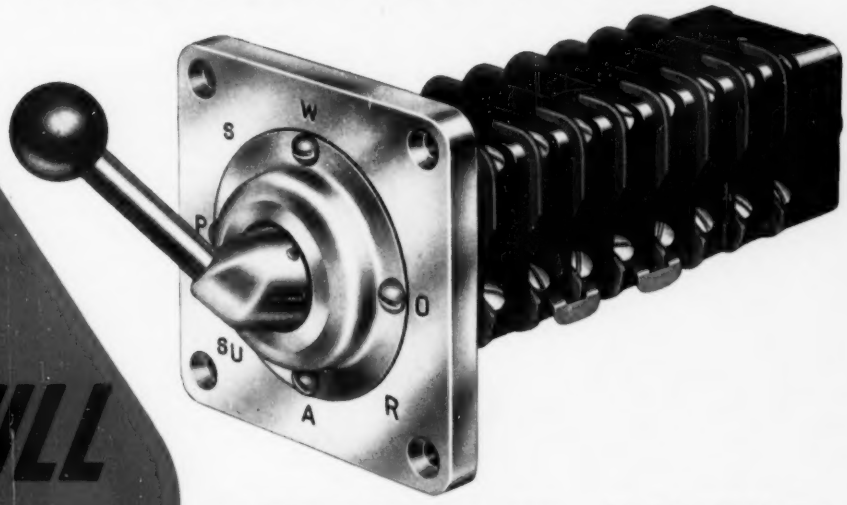
COMPLETE DATA is recorded when a sample coil is received and stripped. This data is checked against engineering records, then is used as the basis for double checking against each step-by-step operation as coils are reproduced.

This is IT!

ONE POINT of CONTROL for ANY APPLICATION

with the

ARROW AH HART



PUSH-PULL SELECTOR SWITCH

SAVES APPARATUS AND SPACE . . . PROVIDES SIMPLIFIED CONTROL

COMPARE
A 2-SPEED REVERSING LATHE
8 OPERATIONS
involving spindle motor, coolant motor, brake and a "Safe" position.

CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	1 Magnetic Unit
7 Push Buttons	1 "PPS" Switch
11 UNITS . . .	SAVED

COMPARE
A DRY CLEANING MACHINE
8 OPERATIONS
involving fan, pump, washing and extractor motors and "Automatic" and "Off" positions.

CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	3 Magnetic Units
1 Timer	1 Timer
14 Push Buttons	1 "PPS" Switch
16 UNITS . . .	SAVED

COMPARE
AN AUTOMATIC BAKELITE PRESS
8 OPERATIONS
involving a choice of jogging for each separate function or completely automatic cycling.

CONVENTIONAL CONTROLS	AH "PPS"
6 Magnetic Units	2 Magnetic Units
1 Timer	1 Timer
9 Push Buttons	1 "PPS" Switch
12 UNITS . . .	SAVED

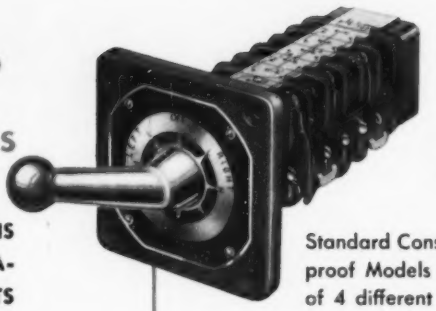
THE SIMPLE ANSWER TO YOUR COMPLEX CONTROL PROBLEMS

REDUCES CONTROLS REQUIRED • SAVES SPACE and WEIGHT • IMPROVES LAYOUT and APPEARANCE • ADDS FLEXIBILITY, VERSATILITY • PROVIDES MAXIMUM SPEED, EASE and SIMPLICITY of OPERATION • FOOLPROOF, PROTECTS OPERATOR and EQUIPMENT • ASSURES PEAK PERFORMANCE

TURN THE PAGE FOR AN ELECTRICAL DESCRIPTION and OPERATIONAL FEATURES

Control TAILORED TO YOUR EXACT NEEDS

— THE ARROW-HART "PPS" SWITCH IS CUSTOM BUILT TO YOUR SPECIFICATIONS FROM STANDARD COMPONENTS



STANDARD CONSTRUCTION WITH CAST LEVER HANDLE ILLUSTRATED

Standard Construction or Oil and Weatherproof Models are available with a choice of 4 different Handle Types.

What the "PPS" does

- **A SINGLE "PPS" UNIT PROVIDES SINGLE-POINT CONTROL . . .** involving practically any desired circuit arrangement.
- **THE "PPS" REDUCES THE NUMBER OF CONTROLS REQUIRED**
  - — because it is the **ONLY** pilot device required for practically all installations.
  - — because the "PPS" makes a single ***MAGNETIC*** control (starter, contactor etc.) do the work of many.

Here IS THE BASIC OPERATING PROCEDURE SIMPLE AS A-B-C

A **PUSH and TURN TO SELECT . . .** The operator must first push the handle — opening all circuits and disconnecting all controls. The handle can then be turned to any desired position; this selects the correct circuits for the required function. Any number of unwanted, intermediate functions can be passed without energizing their circuits.

B **PULL TO START . . .** With the handle in the desired position, the handle is pulled to start the operation — the same as actuating a conventional "Start" button.

C **PUSH TO STOP . . .** Pushing the handle immediately stops the operation. "PPS" single-point control is safer in emergencies because there is never a delay to find the right button.

Tested, Accepted...and Acclaimed

Leading manufacturers and designers of new equipment, plant engineers and maintenance men, and operators everywhere who have worked with and know the "PPS" are universally sold on its benefits. Although it is revolutionary and relatively new, the "PPS" has been thoroughly tested on innumerable installations and found OUTSTANDING.

LT WILL PAY YOU TO KNOW MORE ABOUT THE ARROW-HART "PPS" SWITCH

This new concept in motor control can help solve your present tough control problems . . . and help you build peak performance into your new designs. Use the coupon, attached for your convenience, to send for completely descriptive literature including a sample Target Sheet for plotting your circuit requirements.

Industrial Control Division
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 Hawthorn Street, Hartford 6, Conn.

Please send me ☐ complete information about the Push-Pull Selector Switch. ☐ Also the A-H Design Story folder featuring Type "RA" Magnetic Motor Controls.

NAME _____
CO. NAME _____
POSITION _____
ADDRESS _____
CITY _____ **ZONE** _____ **STATE** _____

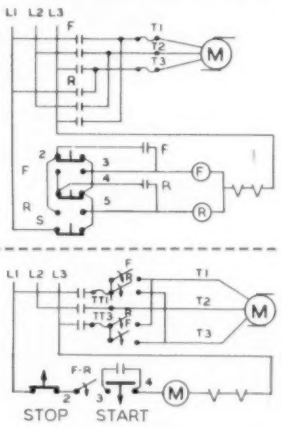
How the "PPS" works

To explain the action of the "PPS", let us look at an example; the simplest possible is the standard reversing of a motor. This example will show how the required number of magnetic units is reduced and how single-point control will serve for any number of operations.

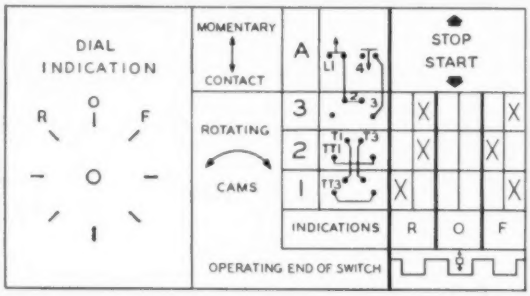
While your own actual control application may be more complex than this example, it will simply entail using enough additional circuits to accomplish the required combinations of load and control hook-up.

CONVENTIONAL CIRCUIT . . . This diagram shows the familiar type of reversing circuit. 3 push buttons and 2 magnetic units are required.

"PPS" CIRCUIT . . . Here the Rotating Cam Sections of the "PPS" select the circuit, and the Momentary Contact Sections operate the motor as desired. The diagram also shows the symbol used for "Stop" by pushing and "Start" by pulling. Only *1 magnetic unit and 1 pilot device, (the "PPS"), are required.*



THE "TARGET SHEET" . . . shown here in abbreviated form, is the means by which your control requirements are translated into a diagram for the construction and wiring of a "PPS" Switch. A wiring diagram strip shield is visible from the top of every switch you buy indicating the terminals and all internal and external connections on the "PPS".



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ARROW·HART
INDUSTRIAL CONTROL DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
HARTFORD 6, CONN., U.S.A.

Offices, Sales Engineers and Warehouses in: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Syracuse. Sales Engineers in Columbus,O., Fayetteville, New York, Manchester, Ct., Seattle, Springfield, Mass., York, Pa. In Canada: Arrow-Hart & Hegeman (Canada) Ltd., Mt. Dennis, Toronto.

as number of turns, dimensions, shape, size of wire, type of insulation, etc) is sent to the engineering and scheduling department. Here the initial data is checked against coil catalogs, order and mold numbers are recorded, wire requirements are listed and are immediately subtracted from perpetual inventory cards.

These lists of materials are then sent to the stock room where wire, insulation, tape, molds and other accessories are assembled.

As coils are being fabricated and processed, each operation is checked against data records, and the final coils are given complete checkups to assure maximum accuracy.

Operations are performed under high-level fluorescent lighting, and they are accomplished with the aid of such modern shop equipment as ovens (having thermostatic controls, time limit controls, recirculation and exhaust systems), automatic wire measuring and shearing equipment, vacuum and pressure tanks for varnish impregnation, gas-fired and water-cooled hot and cold coil presses and the like.

By constantly checking information against step-by-step operations, using good equipment and materials, training new men for specific jobs and recording all pertinent data, this company has, over a 35-year period, developed a reputation second to none.

FLEXIBLE EXHAUST connection removes combustion fumes when gasoline-driven electric welder sets are under test in the motor repair shop of the Clarence W. Silver Company in Salt Lake City, Utah. A 25-foot length of 2-in. flexible hose (arrow) is rope-and-pulley suspended from shop ceiling; permits testing within a 30-foot radius. One end connects to engine exhaust muffler, the other goes outdoors.

SOUNDSCRIBER, Executone intercom system, planned lighting, air conditioning and acoustical ceiling tiles in the office of W. Earle and William H. Braunlich have definitely improved accuracy, promptness and general efficiency of office routines.

Shop Efficiency Aided By Modern Office Equipment

Far too many repair shops have bottlenecks in their offices, where poor lighting, excessive noise, cramped quarters and poor communication facilities contribute to errors, interruptions, wasted time and general inefficiency. Not so in the office of Braunlich-Roessle, one of NISA's outstanding shops serving the Pittsburgh metropolitan area.

Reasoning that modern office equipment and good working conditions are integrally connected with clear thinking and maximum output, W. Earle and William H. Braunlich have equipped their office with a Soundscriber and an Executone inter-office communication center, both pieces of equipment being located conveniently between the two desks. It is thereby possible to record memos directly from telephone conversations, or to obtain prompt answers from the shop foremen, shipping clerk or bookkeeper when a customer calls for information on the phone. Without having to leave their desks or summon a stenographer, they can make notes, dictate letters, check the progress of repair work, the status of inventories, accounting data and the like.

They have also discovered that an acoustical ceiling pays dividends in the form of clearer hearing on the phone, fewer mistakes in the transmittal of information, faster calls due to the elimination of repeated phrases, and greater concentration on routine office matters.

Adequate illumination in the order of 45-footcandles on working surfaces also speeds up reading and filing, makes it easier to check drawings and blueprints, prevents eyestrain and minimizes fatigue at the end of the day.

Also contributing to physical comfort, higher morale and sustained mental alertness is an air-conditioning system controlling temperatures and humidity during the warm summer months.

While none of these features concern shop methods as such, they all contribute to the efficiency of an organization which is noted for prompt, courteous service and high quality workmanship.

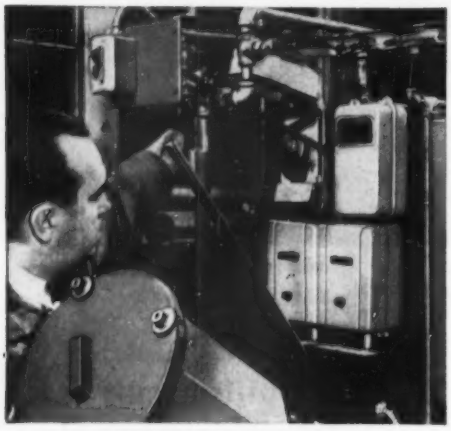
Drip Tank Has New Slant

Several practical features are combined in the installation of a drip tank installed in the motor repair shop of the Pacific Electric Motor Company of Oakland, California. The tank is used to catch the drippings from freshly immersed coils, and the residual insulating varnish is salvaged by collecting it in a well.

The drip pan is constructed on an incline, so that any varnish landing on this surface makes its way by gravity to the low end where the removable well is located. Since the varnish on this incline plane is rarely more than a fraction of an inch deep, the front lip of the plane follows the incline rather than having the top lip horizontal as is generally the case. This cutting away of the front wall keeps the tank open, facilitates cleaning and does not restrict the arm movement of the worker who hangs or removes the coils from the overhead racks.

When the tank is not in use, a cover is placed over the well, thereby

Save Time, Manhours, Power Costs, With G-E Time Switch Applications



EASY TO READ AND ADJUST

POWERED BY A TELECHRON® MOTOR

A G-E TIME SWITCH FOR EVERY ON-OFF JOB

Uses for time switches range throughout on-off jobs in farm, shop, home

When you buy a General Electric time switch, you get a product which will give you more dependable, more accurate service. G.E. has a complete line of time switches—one for every on-off operation.

HERE'S HOW YOU SAVE:

- Reduce manpower needs
- Cut power consumption
- Reduce waste, spoilage
- Get greater efficiency

MACHINERY CONTROL

On-off control of pumps, compressors, water softeners, mixers, tumblers, and die cutting equipment, etc., can be done easily and efficiently with a G-E time switch.

LIGHTING CONTROL

Time switch control of parking lot and apartment house lights, store and shop-window lights, signs and spectaculars, plant and farm floodlights, means more economical, efficient utilization of equipment and power.

CONTROLLING AIR-CONDITIONING UNITS

Using time switches means that the unit is off when not in use, and on *prior to the time when the building will be occupied.* Automatic control means savings in wear and tear on the unit, and in lowered cost for operating power.

PRE-HEAT CONTROL

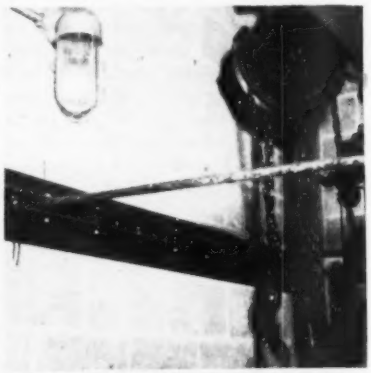
Make possible heating ovens before the work day begins—save manhours lost in waiting for units to reach required temperatures.

ORDER TODAY

Contact your authorized G-E Agent or Distributor, or write for Bulletins GEC-535 and GEC-578, Section 603-146, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

CUTAWAY FRONT of the inclined drip tank facilitates arm movement of employees, cleaning of tank and visual inspection of the area. Gravity returns all residual varnish to salvage well which is covered when not in use.

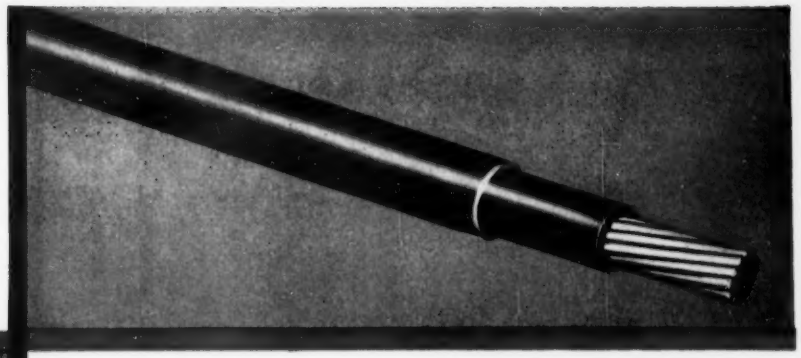


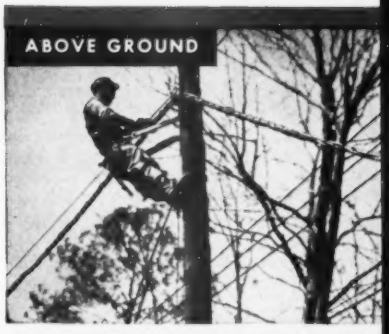
SERIES OF CONDUIT STUBS bolted between the horizontal flanges of two wall-mounted angle irons provide many anchors for the movable bars that are used to support coils. Lighting fixture is vaporproof.

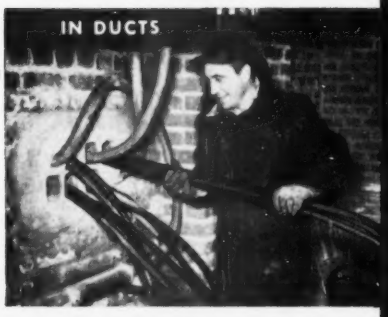
precluding the deposit of debris in well.

The overhead racks consist of lengths of round bar stock inserted into conduit stubs held firmly between the horizontal flanges of two angles which are first bolted together, then bolted to the shop wall. This arrangement of the angles and conduit stubs provides many closely-spaced anchor positions for the round rods, and the bars can easily be moved from one anchor to another in accordance with the width of the coils being supported.

Chain hoists are supported by roller assemblies that slide along the lower flanges of an overhead I-beam, thereby providing a means of transporting heavier loads (such as an armature) from the dipping tank to the dripping area. Illumination over the drip tank is obtained from a vaporproof light mounted on the shop wall.







You can depend on neoprene-jacketed cable in all types of service

RURAL • RESIDENTIAL • INDUSTRIAL

Wherever it's installed, neoprene-jacketed cable gives long, trouble-free service. Above ground, neoprene-jacketed cable outperforms other types because of its unequaled resistance to deterioration from sunlight and weathering. In heavily industrialized areas, neoprene stands up in corrosive atmospheres . . . is ideal protection for both primary and secondary power cable.

Underground, buried direct or installed in ducts, neoprene resists attack from soil acids. Unlike metallic coverings, it is not damaged by electrolytic action caused by stray currents.

Cable manufacturers supply neoprene-jacketed cable in single and multiple conductor types in a range of voltage ratings. Since the same cable is often suitable for different uses, lower inventories are possible. And remember, a neoprene jacket assures longer life, fewer repairs, less frequent replacement even in the most severe service. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division EC-7 Wilmington 98, Del.

NEOPRENE

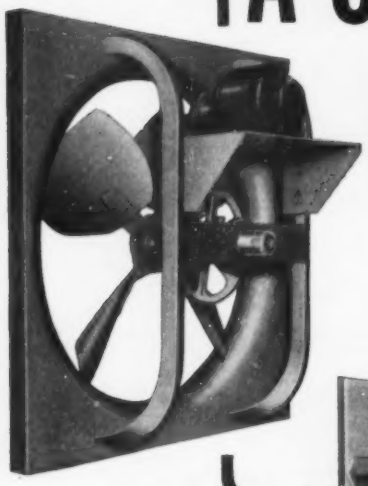
The rubber made by Du Pont since 1932

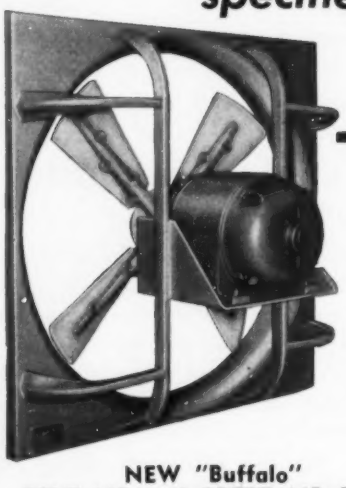
DU PONT

Better Things for Better Living . . . through Chemistry

A CINCH TO INSTALL

—and sure to perform as specified





• *Above, the attractive new Belt-Air Wall Panel Fan*

• *Right, the new, highly versatile "Buffalo" Type "NV" Heavy-Duty Design 80 Propeller Fan*

"Buffalo" FANS

NEW "Buffalo" BELT-AIR and BREEZ-AIR FANS

Major design changes in both wall panel Belt-Air Fans and Breez-Air Attic Fans provide: (1) higher capacities at lower, quieter speeds and lower power consumption, (2) fan operation at any angle from horizontal to vertical, shaft-up, because of a new sleeve bearing design on fan shaft, in 24", 30" and 36" sizes; (3) quieter operation than ball bearing designs. Write for details on these rugged, easily installed package fans. Like all "Buffalo" Fans, their installed performance is as good or better than "on paper"—and that means more satisfied customers for you.

NEW "Buffalo" Heavy-Duty "NV" PROPELLER FANS

Talk about flexibility—you can operate these husky 4-bladed fans on either free air delivery or against pressures up to 1" with very stable performance and high efficiency. Pick either Direct or V-belt Drive, in sizes from 24" to 84", or 4,000 cfm to 90,000 cfm—a range of easily installed fans to handle any job you'll run into—to perfection. Write TODAY for Bulletins!

First For Fans

BUFFALO FORGE COMPANY

520 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

PANEL BREEZO FANS | BELTED VENT SETS | BELT-AIR FANS
BREEZ-AIR ATTIC FANS | "L" BREEZO FANS | "NV" BREEZO FANS

GRIPPER SLING, made by Cambridge Wire Cloth Company, is used by Herr Electric Company of Baltimore to cradle motors and lift them to or from the tailboard of delivery truck. Woven web grips motor securely, preventing possible danger to parts or to personnel through slippage or droppage.

Woven Wire Sling Lifts Heavy Equipment

The Herr Electric Company of Baltimore, Md., has been using woven wire slings for the past year to facilitate the handling of heavy or bulky parts or equipment in their motor repair shop. These slings have proved useful for lifting all types of motors, but they are particularly helpful in the handling of some of the newer motor models that are constructed without eyebolts on the frames. The woven texture of the slings prevents slipping for, when wrapped around a motor in a noose arrangement, the web grips the load snugly and securely.

Not only are these slings used to unload, transport or load motors for shipping, but they facilitate the positioning of armatures in lathes—a job that formerly required two or three men to handle some of the larger units.

The gripping potential of these slings, manufactured by the Cambridge Wire Cloth Company of Cambridge, Md., insures the motors against damage from dropping. It also protects the men in the shop—a fact emphasized from past experiences where previously-used belts slipped, permitting the motor being carried to drop, narrowly missing operators' feet.

Operators in the shop have made numerous reference to the advantages to be gained. These favorable comments indicate that materials-handling times have been cut by from 30% to 50%; there is no danger of damaging the ends of the armature coils as has happened with other types of slings; the flexing of the woven wire sling prevents it from becoming slippery

The Right Motor Price... At Your Fingertips

THIS HANDY CONDENSED PRICE LIST HELPS YOU SELL MORE Century MOTORS

Increase your sales by serving your customers motor requirements. Ask for a copy of Century's Condensed Form 943 Price List.

This is only one of the ways Century wants to help your organization to sell motors.

This popular Condensed 4 page folio, Century Motor Price List, covers more than 90% of the types and sizes used in the markets served by Industrial Distributors.

Its simplified form helps the distributor salesmen to more readily find and quote motor prices.

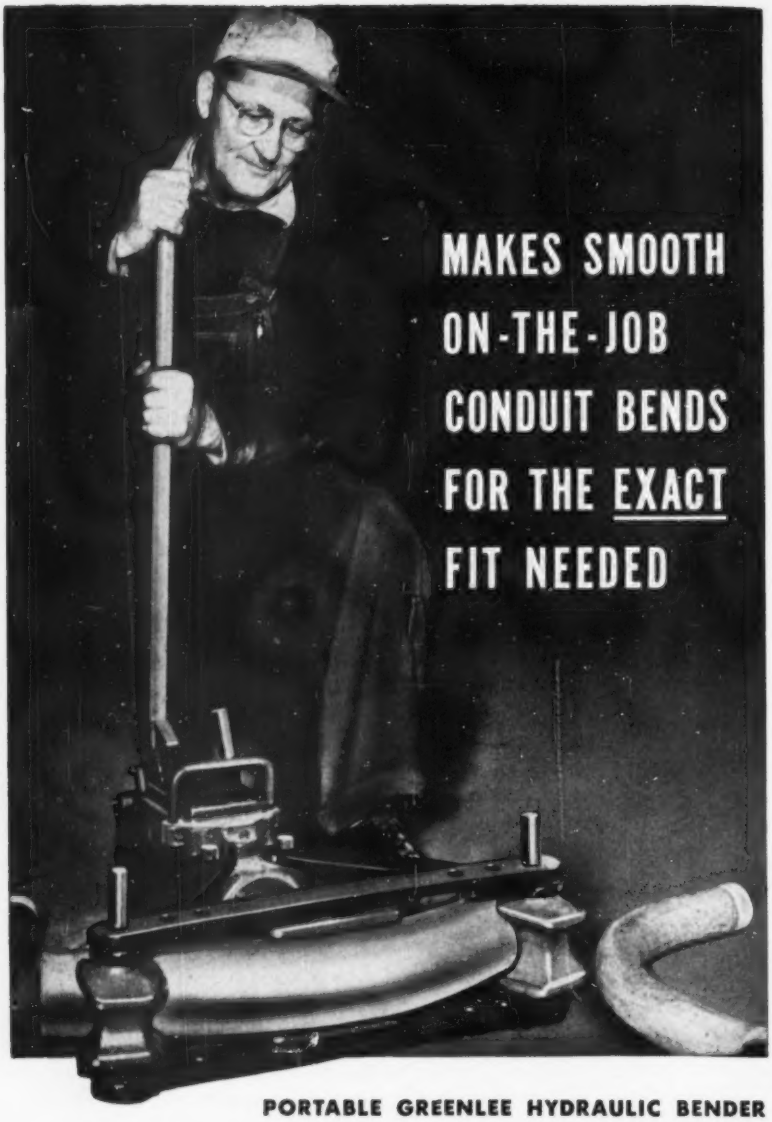
The Century Condensed Motor Price List was designed with the sales problems of the distributor's salesmen in mind. With his wide line of products, he cannot carry a thick Century price book that includes complete engineering data for every possible special motor application. Call on a Century salesman to help you on your special applications.

Complete books covering Century's most complete line of motors and generators are available to those who want them.

CENTURY ELECTRIC COMPANY • 1806 Pine St., St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

Century MOTORS



PORTABLE GREENLEE HYDRAULIC BENDER HELPS BEEMSTER ELECTRIC COMPANY DO PRECISE WORK, SPEED JOBS, SAVE HARD-TO-GET MATERIALS

On its first big job for the Beemster Electric Company, Green Bay, Wisconsin, the GREENLEE Bender more than proved its worth.

As reported by C. M. Peot, Beemster's manager, their bender at times was taken 200 feet in the air to make "on location" conduit bends atop a large storage elevator. This eliminated need for many manufactured bends, or taking time out for custom bending . . . and, most important, resulted in getting accurate bends that could be fitted in exactly as needed!

Besides the portability feature of the GREENLEE, this contractor also points out that the ram measurement markings let you gauge bend radius accurately for making exactly matching bends. And changes from one pipe size to another are made easily, quickly.

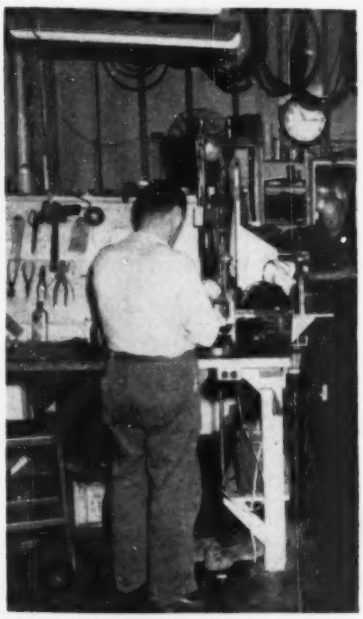
Let the one-man-operated GREENLEE speed and simplify your jobs, too. In minutes makes smooth, accurate bends in pipe up to 5", rigid and thin-wall conduit, tubing, bus-bars. Often pays for itself on the first job. Write for facts today. Greenlee Tool Co., 1747 Columbia Avenue, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK
Hand Benders • Joist Borers • Cable Pullers • Knockout Tools • Auger Bits and Drills

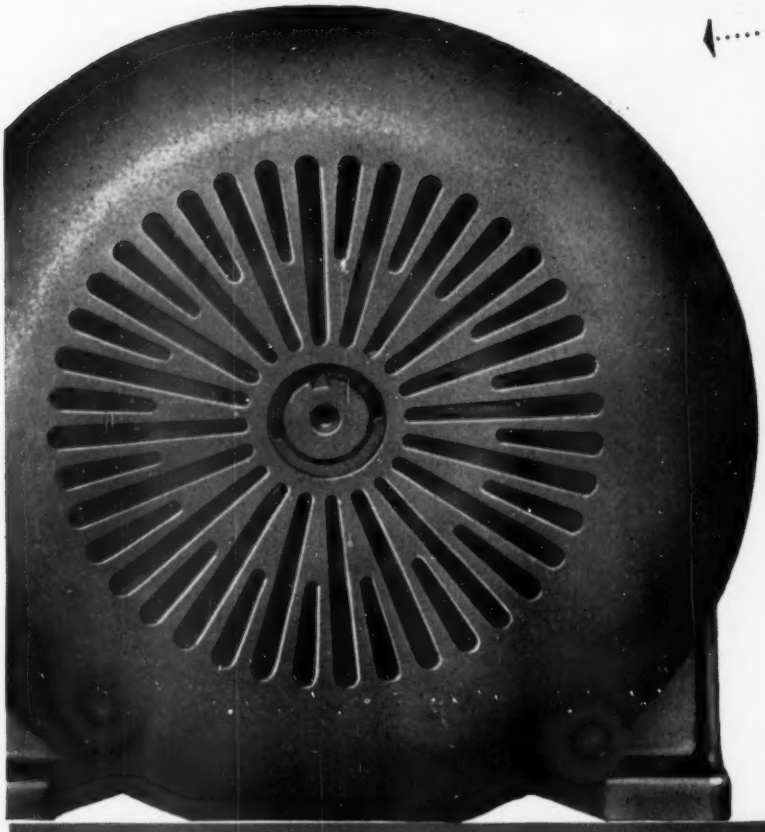
ARMATURES may be lifted into position for lathe work by one man rather than by several. Flexing of the web between operations prevents grease from caking on the belt and creating slippery condition. Operators claim that handling time is reduced, safety improved, sling life lengthened.

from accumulations of grease; injury to parts or personnel is improbable; one man can now do a job formerly requiring several helpers. While slings are used in noose form for most motor equipment, they may also be used as a basket hitch with both handles on the hoist hook to suit the equipment.



DUAL WORKBENCHES in shop area (left) of A. G. Lakore Electric Motor Repair, Inc., Winona, Minn., have tilted wood backboards down center line. Hand tools are racked on these boards within easy reach of mechanic. Dark silhouettes painted on board show when tools are not in proper place or missing.

DEPENDABILITY...
that builds reputation
Delco Motors



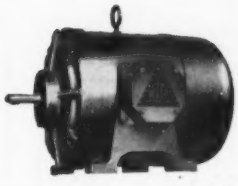
If your product needs a power source, look to Delco for the motor that will serve you best. Delco makes motors for most industrial applications . . . motors famous for dependability and long life under the toughest operating conditions.

So . . . check on Delco. You'll find a Delco motor that fits your needs. For complete details write to Delco Products, Dayton, Ohio, or to the nearest sales office listed below.

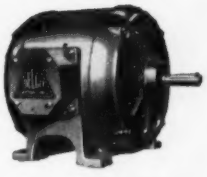
DELCO
DAYTON OHIO

DELCO PRODUCTS

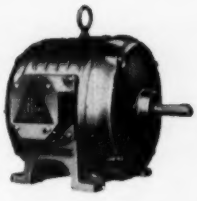
Division of General Motors Corporation
Dayton, Ohio



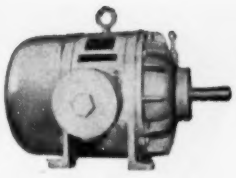
Totally Enclosed Fan-Cooled Motor



Open Ball-Bearing Motor



Totally Enclosed Motor

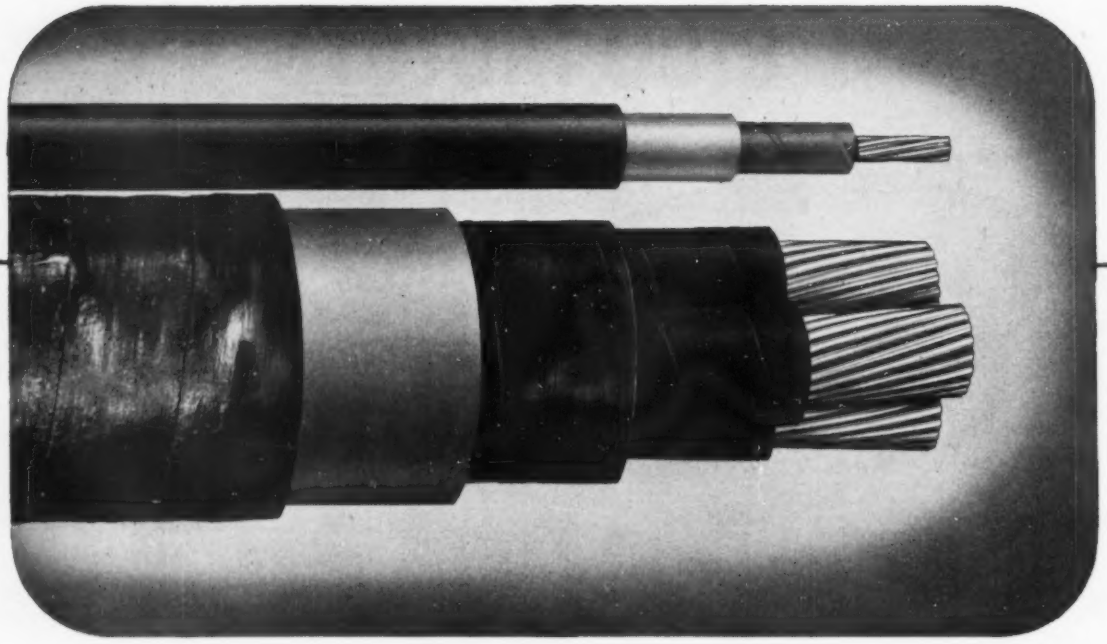


Explosion-Proof Motor

SALES OFFICES: Atlanta • Chicago • Cincinnati • Cleveland • Dallas • Detroit • Hartford • Philadelphia • St. Louis • San Francisco

ROEBLING PROTECTIVE COVERINGS ON LEAD SHEATHED CABLE

for utilities, chemical plants and the petroleum industry



LEAD SHEATHED CABLES used in certain applications by public and private utilities, chemical plants and the petroleum industry are often impaired by electrolysis or chemical corrosion. But such corrosive action can be effectively reduced, and cable life extended, by using Roebling Paper Insulated and Varnished Cambric Cables with either of two outer protective coverings.

One of these coverings is an extruded thermoplastic sheath employing a special high-molecular weight polyethylene. The other is ROESHEATH, built up of neoprene and neoprene-filled fabric tapes and vulcanized directly over the lead sheath. Both coverings not only provide essential protection, but, in some cases, may permit the thickness of the lead sheath to be reduced.

For longer, more dependable cable life and worthwhile economy write for full information... and get our recommendations for solving any special problem.

John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

A subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST & 5 PITTSBURGH ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST & 120 S. HEWITT ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • PITTSBURGH, 1301 CLARK BLDG • ROCHESTER, 1 FLINT ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • ST. LOUIS, 3001 DELMAR BLVD • TULSA, 321 N. CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, NEW JERSEY

CF&I

JR ROEBLING

Practical Methods

Lighting Fixture Schedule

SPECIFICATION

The possibility of misunderstanding on the part of contractors, suppliers, architects or engineering personnel is virtually eliminated when an electrical specification is as exact and detailed as those prepared in the office of consultant Thomas B. Hunter of San Francisco.

As an example, his typical lighting fixture schedule includes not only a wiring plan symbol, location and preferred manufacturer, but catalog numbers, cross-section sketch of the unit, illumination distribution curves, connected loads (including ballasts with lamps), and mounting heights.

The time required to include this related and necessary data in the specifications pays big dividends in coordination of effort between various trade groups on the job. It insures a clear understanding between supplier, supervisor, installer and owner; and valuable information for those who are ultimately responsible for the system's maintenance.

FIXTURE SCHEDULE

SYMBOL	FIXTURE TYPE	CATALOG NO.	LAMPS AND TOTAL LOAD	LOCATION	MTG. HT.
1-100 1A-100	0% 79%	BENJAMIN NO. 40762 INSTANT START	2-40 W "F"	BASEMENT 1st FLOOR GARAGE	10'-0" UNLESS NOTED.
		BENJAMIN NO. 49362-CL VAPOR-TIGHT	2-40 W "F" 100 W.	BASEMENT WASH RACK	AS NOTED
2-100	0% 5%	DAYBRITE NO. 4223S CO INSTANT START	2-40 W "F" 100 W	GARAGE ENTRANCE RAMP & HIGH CEILING	CEILING
3-100 3-200	PRISMATIC LENS	SECHRIST NO. H22195 BOX 8" x 8" x 5 1/4" DEEP	1-100 A 100 W	TOILET ENTRANCES.	CEILING
		HOLOPHANE NO. F1774 BOX 13 7/8" x 13 7/8" x 10 7/8" D.	1-200/1F 200 W	TOILETS	CEILING
4-100 4-200	OPAL GLASS	PEERLESS P 489 NV	1-100 A 100 W		CEILING
			1-200/1F 200 W	CORRIDORS	
5-200 5-100	0% 79% MH 6'-6"	BENJAMIN NO. 9643 (CEILING) BENJAMIN NO. 7643 (PENDENT) BENJAMIN NO. 7641	1-200/1F 200 W	SUB-BASEMENT ELEVATOR MACHINE ROOMS. STOREROOM FLOOR 22nd FLOOR	CEILING or AS NOTED
6-50 6-200 6-100 6A300		BRYANT NO. 4273 KEYLESS PORCELAIN LAMPHOLDER WITH PULL CHAIN	1-50 A 50 W ⚠ 200 W	TEL. CLOSETS JANITOR'S CLOSETS ELECTRIC CLOSETS STORAGE	CEILING WALL-6'-6" or AS NOTED
7-200		COLUMBIA SPP 275 (48" SECTION SPP 236)	3-75 W T-12 96" 200 W	GENERAL OFFICES 10'-6" CEILING	STANDARD PENDENT
7A-200		COLUMBIA SHG 275 (48" SECTION SHG 236)	3-75 W T-12 96" 200 W	GENERAL OFFICES LOW CEILING	CEILING
8-50 8-100	TO REMOTE BALLAST IN CEILING T 12 SLIMLINE ALBALITE GLASS	BOYD LIGHTING FIXTURE CO. NO. 816	1-48" T12 1-96" T12	OVER MIRRORS IN WOMEN'S TOILETS	SEE ARCH. DWG.
9-200		HOLOPHANE NO. 612 WITH NO. 0865 BRACKET	1-200/1F 200 W	OUTSIDE COURT ROOF PENTHOUSE	WALL 6'-6"
10-100		BENJAMIN NO. 7123 VAPOR TIGHT	1-100 A 100 W	IN AIR WASHER NO. 1	CEILING
11-100		HOLOPHANE H 2076 BC	1-100 A 100 W	Rm. 368	CEILING
13-300 13-500 13-750		INDIRECT INCANDESCENT FIXTURES FURNISHED BY STD. OIL Co.	300 W 500 W 750 W	PRIVATE OFFICES	STANDARD PENDENT
14-100		PRESCOLITE #1010-6115 SQUARE FRAME	100 W	CUBBIES 18th FLOOR	CEILING
15-100		PIN-HOLE SPOT WESTLITE #07528 BOTTOM ACCESS	1-100 W G-16½/2 SC SPOT LIGHT LAMP	RM. 1871	CEILING

PLYWOOD CASES with handles on their sides make handy book shelves for job-site reference. When job supervisor moves to a different project the cases may be lifted down, tossed in a truck, or sealed with plywood tops and shipped to the new field office.

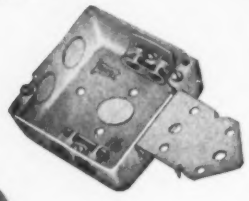
Reference File For Job-site Ordering

CONSTRUCTION

Grant Electric Company of Cleveland, Ohio, finds that time can be saved and accuracy of ordering material directly from a job field office can be insured by equipping the field office with a library of reference catalogs similar to the one existing in the main office. When a job supervisor requires a particular item, he can check it in the catalogs which he has in his field shack, then phone in to the main office to request that it be sent out from stock or ordered immediately. Since the purchasing agent in the central office has a similar file of catalogs handy, any questions or differences in material can be discussed and answered promptly and with complete understanding by both parties. This procedure has saved days in delivery intervals, and bottlenecks of supply have practically been eliminated.

Catalogs are kept in plywood cases which, when turned on their sides and placed one on top of another, make very satisfactory book cases. Sturdy handles are bolted to the sides of these cases to facilitate handling. This arrangement provides a convenient storage space for all reference material and the cases may be transported easily without deranging the order of the material contained therein.

COBX
For Metallic Cable



COB-½
For Conduit

COBLX
For "Flex"

3 RACO boxes that give twice as much wiring space...

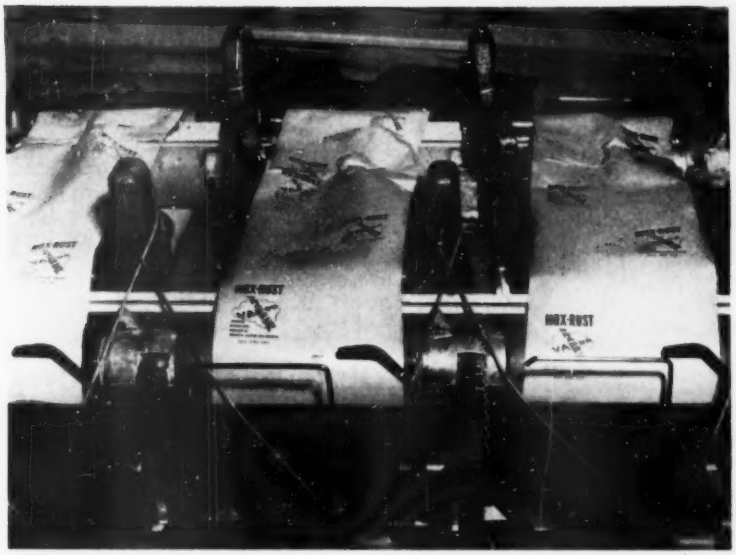
These RACO electrical boxes handle double the capacity of the usual box — as many as *eight* number 12 wires — at a cost of only a few cents more. Think what this means in extra wiring space and reduced cost. Here is another example of the installation speed, convenience, and economy that are found in RACO electrical boxes. They are available nationally.

You can always rely on RACO

RACO

ALL-STEEL EQUIPMENT Inc. — 800 Kensington Ave., Aurora, Illinois

"A BOX FOR EVERY NEED"



WRAPPING PAPER impregnated with a volatile chemical which inactivates moisture in the air surrounding packaged equipment or machinery prevents corrosion or rust from marring the surface of metal parts being shipped to distant destinations or being stored for lengthy periods.

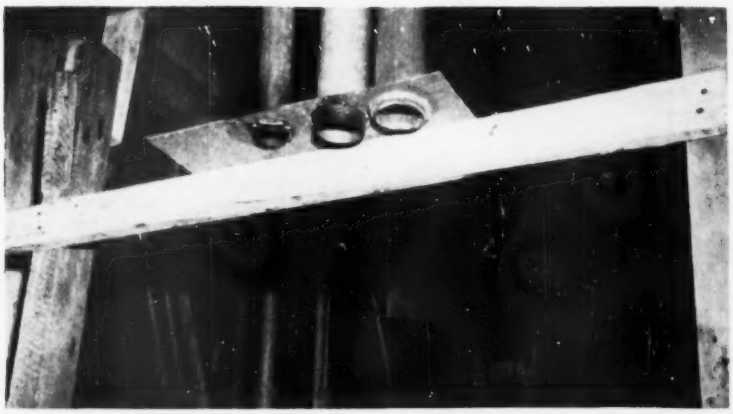
Shipments Protected by Rust-Inhibiting Wrapper

TRANSPORTATION

Electrical contractors and manufacturers who must guarantee the condition of equipment being shipped to foreign countries or distant destinations within the territorial U. S. are finding that rust can be inhibited if the equipment is wrapped with a special material. According to the Universal Winding Company of Providence, R. I., the technique has resulted in impressive savings because it eliminates the necessity to grease or oil equipment prior to shipping and it abolishes the time-consuming chore of removing the grease at the point of destination. Parts and equipment arrive factory-fresh, clean and ready to use or install.

Machinery or equipment is first crated in cases lined with this rust-inhibiting paper, and additional sheets of the paper are wrapped around parts that are farther than a foot from the liner.

The paper, called Vapor Wrapper by the Non-Rust Chemical Corporation of Chicago, the manufacturer, is impregnated with a volatile chemical which inactivates moisture in the air surrounding packaged parts, thereby making it noncorrosive. Metal surfaces are thereby protected, and no deposit is left on the metal itself.



STEEL TEMPLATE on wood cross-bar permits conduit work to be completed before panel installations at the University of California's new Teaching Hospital in San Francisco. The Abbett Electric Corporation, project electrical contractor, used this idea to maintain electrical installation progress when deliveries or other construction problems prevented conduit and panels to be mounted at same time.

How To Store Fully-Charged Wet Batteries

INDUSTRIAL

Throughout industry, material handling supervisors, signal engineers and other plant executives occasionally find themselves stocked with a quantity of storage batteries which, for any of several reasons, cannot be put into immediate use. Such batteries can be stored, fully charged, without damage or deterioration if a simple program is put into effect and followed with regularity, according to K. A. Vaughn, manager field engineering, Gould-National Batteries, Inc.

First, store such batteries in a cool, dry room where temperatures will not fall below 60 F or exceed 90 F. Do not stack the crates, but dispose them on the floor so that cells will be accessible for inspection and charging. Naturally, this arrangement will require that narrow aisles be provided for the sake of accessibility.

Tops should be removed from the shipping crates, and all excelsior or other packing material should be cleared away from around the tops of the cells. Once this is done, examine the cells for possible damage in shipment such as cracked jars or spillage. If any damage is apparent, notify the carrier immediately and have the necessary repairs or replacements made without delay.

At 30-day intervals, take hydrometer readings of several cells; if any cell is found to read as low as 1.200 specific gravity, connect the cells in series (negative to positive) and then to a dc source of current where a low rate of charge is available. Connect the positive terminal to the positive lead of the charging source and the negative terminal to the negative lead. Charge at the recommended finishing rate as indicated on the nameplate or in the manufacturer's instructions until a constant voltage and specific gravity are obtained for four readings taken at hourly intervals and while the batteries are on charge.

In case the available charging equipment does not develop sufficient voltage to charge the entire battery at once, the battery may be split up into

TABLE I

Example hydrometer reading	Thermometer reading	Correction	True Sp. Gr.
1.250	87° F	plus 3	1.253
1.210	80° F	plus 1	1.211
1.180	64° F	minus 4	1.176

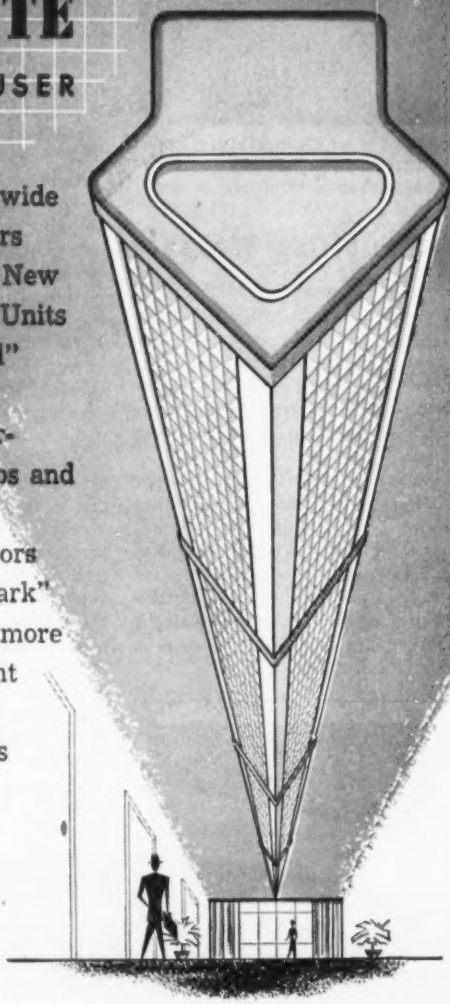
make hallways say, "Come in!"

new Guth V·C·U

with "V" CORRIDOR UNIT

GRATELITE* LOUVER-DIFFUSER

At last—you can fill wide hallways and corridors with practical light! New Guth "V" Corridor Units provide "wall-to-wall" illumination. The GRATELITE Louver-Diffuser shields lamps and is easily maintained. Hallways and corridors "come out of the dark" and turn into safer, more cheerful lines of light that guide the eyes and the step. V·C·U's available in 4′ & 8′, 1 & 2 light models.



*Patents Pending
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Write today on your letterhead for complete information.

Guth

THE EDWIN F. GUTH CO. ST. LOUIS 3, MO.

smaller units and each unit charged separately.

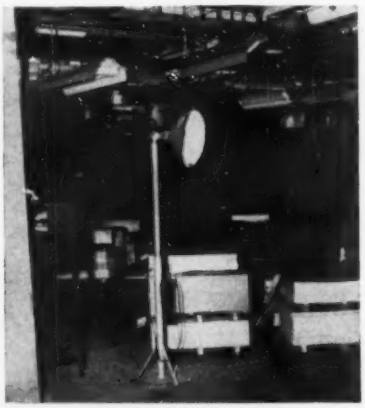
All specific gravity readings must be corrected for temperature (Table I). Correction of these readings for temperature is based on 77°F, with a correction factor of three points of gravity for each 10°F in acid temperature. Using 77°F as a base, add three points of gravity for each 10°F above base, and subtract three points for each 10°F below.

Portable Floodlights Have Many Applications

INDUSTRIAL

The maintenance department at the Continental Can plant near Pittsburgh has fabricated several floodlight assemblies which are used to provide high level illumination in areas or on working surfaces that do not require or do not readily lend themselves to a permanent lighting installation. One such location is on loading platforms, where portable lights may be moved and reflectors positioned so as to direct light inside freight cars or trucks. Another use for the lights is in connection with maintenance or repair of equipment, for again the beam of the light can be directed or shifted to minimize shadows and promote seeability.

The base of the unit consists of a 2-foot metal disc with four steel straps slanting upwards from the perifery of the disc to a vertical section of 2-inch conduit. Connections are made by welding. Also welded to this conduit section are two bent-bar arms that are used to hold the rubber covered extension cord when the fixture is not in



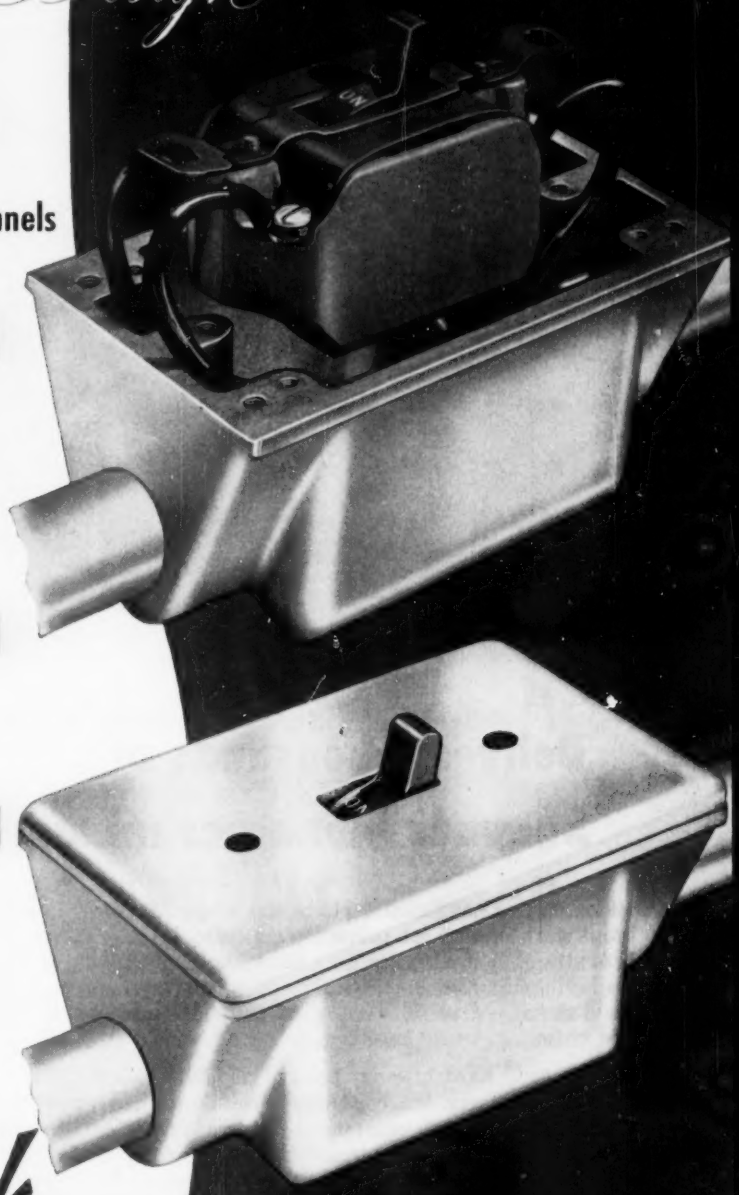
SECTIONS OF CONDUIT, a supporting metal disc fitted with slanting welded steel straps, a swiveling reflector and arms on which to wind an extension cord may be readily assembled to form a convenient portable floodlight unit for maintenance or industrial jobs requiring temporary high-level lighting.

the new KILLARK flush switch fitting

Streamlined Design

in Modern ALUMALLOY

...featuring the exclusive Wiring Channels for easier wiring!



Better Working Area on the Inside!

Again, Killark has pioneered in the manufacture of conduit fittings—with the introduction of this modern, streamlined functional design! The big, roomy wiring channels mean faster wiring. The integral end-wall lug design for the cover means more room for easier splicing, too. And the satin-smooth, burr-free interior means an end to scraped insulation—or fingers!

Better Appearance on the Outside!

The famous Killark sparkling-smooth Alumalloy surface offers a lifetime of overall beauty . . . enhanced by such practical design features as the *inside hubs*—stronger in use, easier to handle.

Better Clear Through!

Of course, all the exclusive advantages of Killark Alumalloy are still there: lightweight, strong in service . . . safe and non-sparking . . . never a worry about the elements or chemical fumes, because Killark fittings are rust and corrosion-free for a lifetime of dependable service.

The new "FS" Fittings come in a wide range of styles and sizes — with covers available for every application.

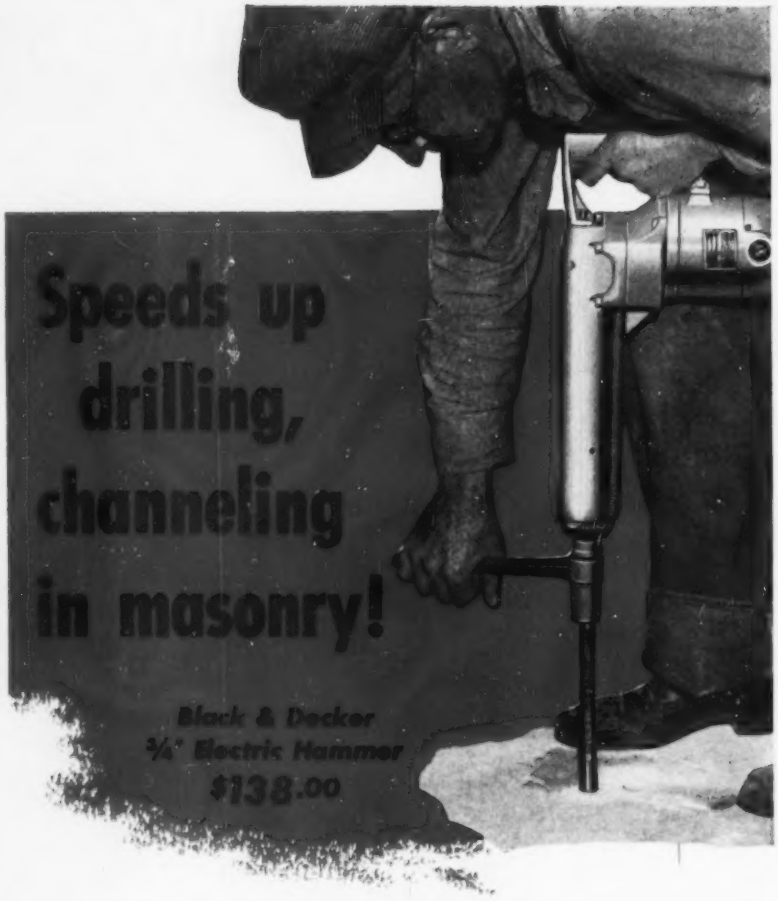
Killark

ELECTRIC MANUFACTURING COMPANY

ENTRANCE FITTINGS • CONDUIT BODIES • FLUSH SWITCH FITTINGS • EXPLOSION-PROOF FIT

Vandeventer and

SALES OFFICES and WAREHOUSE STOCKS	Atlanta	69 Mills Street, N. W.	Dallas
	Boston	156 Purchase St.	Denver
	Buffalo	18 Quay St.	Detroit
	Chicago	1528 West Adams St.	Los Angele
SALES OFFICES	Baltimore	11 W. 25th St.	Columbus
	Cincinnati	49 Central Ave.	Kansas C



Delivers thousands of hammer blows per minute

Black & Decker Electric Hammers eliminate slow, laborious hand work on any job involving concrete, brick or stone. They drill straight, clean holes for anchors or conduit—dig channels for laying conduit—strip flooring, drive fasteners, clean and scale metal—drive a variety of tools for bushing, caulking and chiseling.

High-speed, hard-hitting, husky yet light weight, Black & Decker Hammers are completely self-contained—require no transformer or extra equipment—operate from A.C. or D.C. outlets or a portable generator. See your nearby B&D Distributor for a demonstration of four models, rated by capacity in concrete for drilling ½", ¾", 1⅛" or 2" diam. holes. *Write for free catalog to:* THE BLACK & DECKER MFG. CO., 617 Pennsylvania Avenue, Towson 4, Maryland.

Over 100 Work-Saving Electric Tools!

Black & Decker PORTABLE ELECTRIC TOOLS

use or the convenience receptacle is not far distant.

Into this upright conduit, smaller-diameter sections of pipe are inserted, the inner and tallest pipe having a swivel joint at the top so that the reflector can be directed up or down at will. The reflector is a large RLM dome.

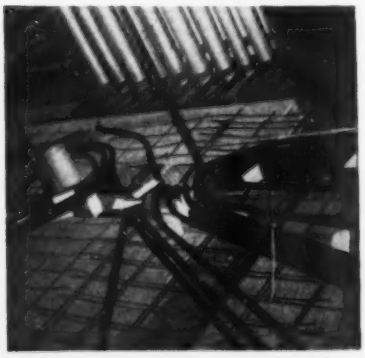
That the maintenance department appreciates the value of directional light is also evidenced in the accompanying photo by the tilted fluorescent units shown above and behind the floodlight standard. This tilting of fixtures is practiced wherever a particular area or machine requires higher-than-normal illumination and *does* lend itself to a permanent installation.

Installation Techniques On Concrete Jobs

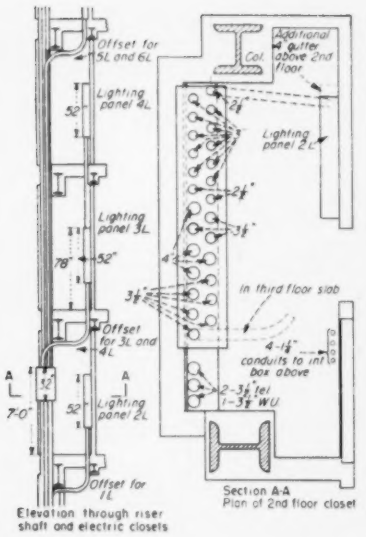
CONSTRUCTION

Installation methods used by Lord Electric during construction of Pittsburgh's Gateway Center included many techniques that can beneficially be applied on any large concrete building project.

For example, electrical crews were sufficiently numerous so that all openings in slabs, outlets, sleeves and inserts could be accurately spotted and established prior to the pouring of concrete, and all outlets and conduit runs were securely anchored or fastened to the reinforcing steel to prevent misalignment or "floating" during the pour. Close liaison was maintained with other trades so that last minute changes in the location of outlets or panelboards, partitions or doorways would not affect the installation of conduit, and electricians were assigned to check the alignment of conduits during the actual pour so that they could be promptly straightened at that time



TAGGED CONDUITS are placed on top of reinforcing steel prior to pouring of slabs and are stubbed down to panelboard templates which are secured to narrow channels in a vertical position by means of spot welds.



CONDUIT RISERS are run upward through the building alongside major structural beam line. Offsets at every second floor provide power connections for lighting panels. Electric closets contain both power and telephone facilities.

in the event of possible derangement.

Conduits were tagged during their installation to insure accuracy of runs, and they were stubbed down from floor-slab forms to panelboard templates securely positioned between narrow channel irons spot-welded to structural beams. Risers were supported at each floor level by pipe clamps formed from strap steel and likewise secured to structural beams by spot welds. Conduit openings were covered with capped bushings to prevent debris from entering these wireways prior to pulling-in of conductors, and outlet boxes were stuffed with paper or burlap for the same purpose. Offsets were established every second floor, one riser serving two panels.

Two-Way Radio System For Plant Protection

SECURITY

Plant protection at G.E.'s 600-acre Schenectady Works is materially improved through the installation of a two-way radio system that maintains constant communication between the plant's 35 base stations in various guard posts, and seven mobile stations installed in plant police cars, fire trucks and ambulances.

This installation is the first system to be used exclusively for plant protection, and the construction permit granted by the FCC is the first of its type in the country. Prior to this, exclusive systems were permitted only for government organizations such as police, fire or forestry organizations.

Threads 4 conduit sizes *fast* with 1 set of dies—*and it won't jam!*

RIDGID

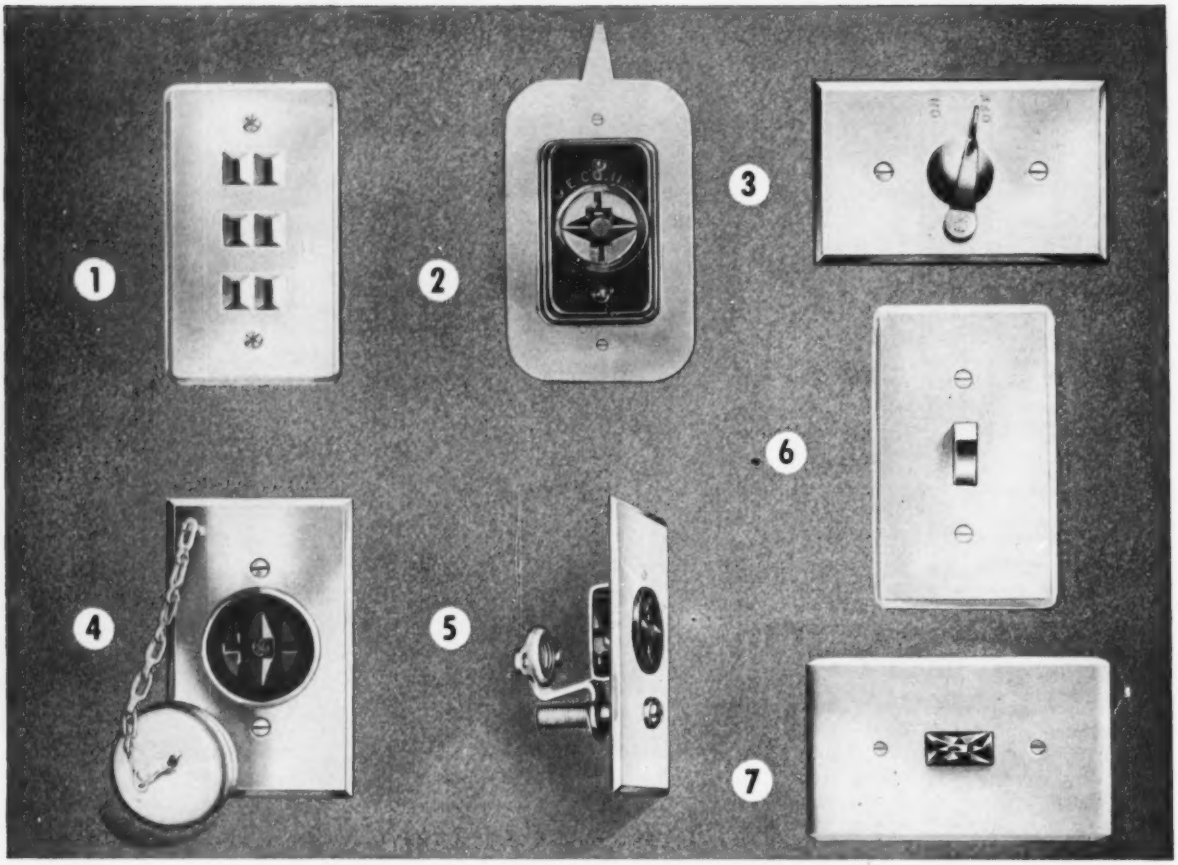
65R CONDUIT THREADER

This popular 65R has saved millions of hours of threading time, and no wonder. Its one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" conduit size in 10 seconds! Mistake-proof self-centering workholder sets instantly! And lead screw won't jam on workholder, kicks out automatically at standard thread length! You can't match it for fast easy conduit threading—buy it at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools



SEVEN G-E WIRING DEVICES
that your customers will appreciate

Here are seven General Electric devices that will give your customers so much extra convenience for so little cost. Why not use them on your next job?

1. **Triple Outlet.** Space-saver—three outlets in the same space as two. Ivory. Catalog No. **RO-1.** Also **RO-2** for switch control.

2. **Clock Hanger**—flush mounted. A neat touch for kitchen or recreation-room use. Cord and plug fit into recess, permitting clock to hang flat on wall. Catalog No. **GE2942.**

3. **Weatherproof Switch.** For dependable service outdoors, on porches, in garages, or other damp places. Catalog No. **GE3024.**

4. **Weatherproof Outlet.** Thoughtful addition to any house for modern outdoor living. Use these outlets on porches, terraces, garages, too. Catalog No. **GE2959.**

5. **Fan Hanger**—flush mounted. For office or home use with swivel- or trunnion-type fans. Mounts in any outlet box. Catalog No. **GE3035.**

6. **Mercury Switch.** Silent, durable, modern. Catalog No. **GE3008** (switch-brown), **RP071-1** (plate-brown), and **GE3088** (switch-ivory), **RP071-2** (plate-ivory).

7. **Pilot-Lite.** Shows when distant lights are on. Is a reminder to turn off porch, garage, or basement lights. Catalog No. **GE853** (pilot light), **GE2331** (bull's eye only), and **RP071-2** (plate-ivory).

New Catalog

For a complete listing of G-E wiring devices, including lampholders, outlets, switches, plates, fluorescent accessories, remote-control wiring, houseware electrics, fuses, and cutouts, with specifications and prices, write for Catalog No. 52A. Address Section D99-718, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

NEW PRODUCTS
CATALOGS, BULLETINS
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After the words "Advertisement on Page"—Insert in the boxes the page numbers of any advertisements about which you want to know more. Where more than one advertisement appears on a page, include the manufacturer's initials.

Please send me without obligation, further information about the following:

Item Number ☐☐☐☐☐☐☐☐
(Product News, Product Briefs, Catalogs and Bulletins)

Advertisement on Page ☐☐☐☐

NOT GOOD AFTER SEPTEMBER 1, 1953

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ELECTRICAL CONSTRUCTION AND MAINTENANCE—A McGraw-Hill Publication

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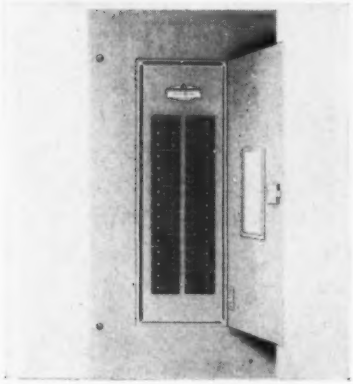
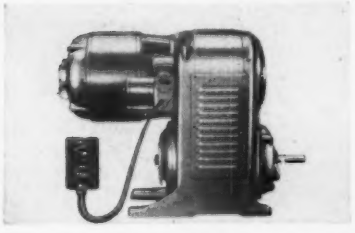
Product News



Panelboard (1)

A new NQP Quicklag P circuit breaker panelboard. It is of the "panel base assembly" design and features the circuit breaker with thermal magnetic overload protection and manual or automatic quick-make and quick-break operation. Available in 10 sizes of enclosures, five with main lug connection and five with main circuit breaker connection, 50 to 225 ampere capacity. Panel base assemblies consist of mounting back with main bus bar lugs and solid neutral. All circuit breakers are interchangeable. Other features are screwless assembly, one pressure type of connection between circuit breaker and bus bar, "sequence bussing" to balance load and permit double pole, individual trip combinations. Capacities are: 15, 20, 30, 40 and 50 amps, 120 volts, single pole or 120-208 volts double pole, individual trip—4 to 42 poles; 120-240 volts, 3-wire single phase or 120-208 volts, 4-wire three phase mains with lugs only or main circuit breaker.

Frank Adam Electric Co., 3654 Windsor Place, St., Louis 13, Mo.



Remote Control Motor (2)

A totally-enclosed auxiliary motor has been developed to provide a positive electrically-driven control for U. S. Varidrive motors. It is called the ERC remote control motor. It is attached to the Varidrive, replacing the control handle, and is operated by a pushbutton. Auxiliary motor is 1/15 hp, 1800 rpm, of the reversible capacitor type. Connection box is part of the unit. By use of the ERC unit, Varidrive can be operated from a control station distant from the motor.

U. S. Electrical Motors, Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.

Silicone Resin (3)

Silicone-glass laminates made with 2105 resin are considerably easier to produce and have improved dielectric life. Laminates can be made at pressures from 300 to 1000 p.s.i. at temperatures ranging from 175 to 250 C. Curing schedules range from three hours press cure to a 30-hour after-cure, depending on the properties desired. Transformer tubes made with 2105 bonded glass cloth have maintained their original dielectric strength after aging at 250°C for more than 1000 hours. Resin 2105 is recommended as a bonding agent for electrical parts that must retain good dielectric properties at high temperatures. Typical applications include transformer tubes used as ground insulation, barrier and terminal strips.

Dow Corning Corp., Midland, Mich.

Tubing Colored (4)

The new "Colorline" E.M.T. is designed to simplify raceway maintenance. A feature of the new thinwall is four tracing lines of the same color—red, blue, yellow or black—spaced 90 degrees apart and running the full length of the tube. Through coding of individual raceway runs, maintenance men can quickly trace electrical trouble; and the colored tubing is also an aid in coding special wiring systems, such as ADT alarm, telephone and intercommunication. Another advantage is that electricians can now make perfect bends and can eliminate dog legs easily.

Nikoh Tube Company, 5000 S. Whipple St., Chicago 32, Ill.

Telephone (5)

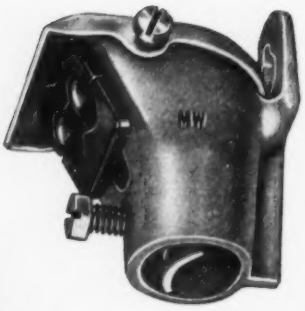
A new explosion-proof telephone is sheathed in two sections of aluminum housing that are made flame-tight by accurately machined joints and large screws. It is powered by sound of the human voice alone. Voice causes fluctuations in the magnetic circuit of the phone's transmitter which creates an electrical current. This current is transmitted to the receiver where sound waves are created, reproducing the speaker's voice. It not only provides for communication in and around hazardous areas but also permits communication with other sound powered telephones within a range of 30 miles. It is equipped with a magneto powered howler that develops a penetrating signal, loud enough to be heard in a boiler factory.

Crouse-Hinds Company, Syracuse 10, N. Y.

Receptacle Cover (6)

A Flush switch screw cap (FSSC) weatherproof receptacle cover has been added to this line. It is supplied with mounting screws and gasket. Made of Allumalloy, which is non-sparking as well as non-rusting and non-corroding.

Killark Electric Mfg. Co., Vandeventer & Easton Aves., St. Louis, Mo.



MODERN

FITTINGS

midwest MW

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

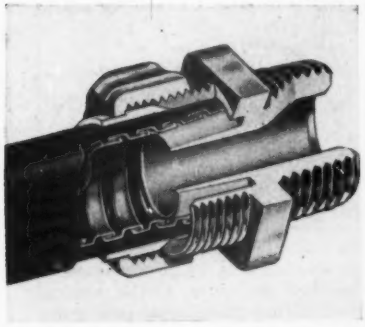
1639 W. WALNUT STREET

Chicago 12, Illinois

Mercury Lamp (7)

A 700-watt mercury lamp, the A-H18 has a recommended minimum mounting height of 24 feet. Giving 35,000 lumens initially, lamp further widens possible uses of mercury lighting by providing a mercury lamp which is especially well suited to medium mounting heights. It can be used in street lighting as well as in flood and general lighting applications. Having an average rated life of 4000 hours, the lamp may be operated from 460 volt circuits with a simple choke and from other voltages with a suitable ballast which also acts as a transformer. Isothermal bulb shape provides approximately even operating temperatures over entire bulb wall. It will burn in any position and is designed to start at low temperatures.

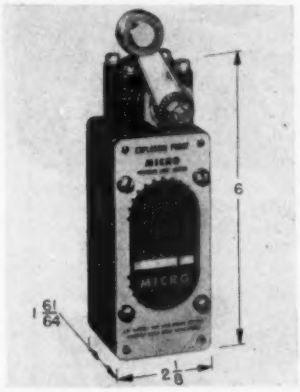
Westinghouse Electric Corp., Pittsburgh 30, Pa.



Fitting (8)

A new fitting for liquid-tight flexible conduit mates with any conduit spiral and does not have to be taken apart when installed. Ideal for machine tool wiring or other similar electrical circuits exposed to corrosive liquids and mineral oils. It is made in straight, 90-degree and 45-degree elbow designs and accommodates conduit from ⅜ to two inches trade size. Only one wrench size is needed for gland and body. A color coded plastic seal in gland indicates a fitting's size and fact that it is a liquid-tight type. When colored seal is visible after installation of fitting, raceway is properly grounded. End of fitting facing junction box has sufficient length to accommodate double locknuts used with sheet metal boxes. Tapered pipe threads provide a liquid tight connection with iron boxes. Since metal spiral of liquid-tight, flexible conduit is enclosed in a plastic tube, fitting ground connection cannot be made outside. This is done inside conduit, where metal spiral's surface is exposed.

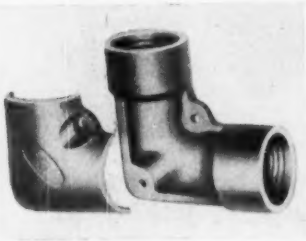
Thomas & Betts Co., Elizabeth, N. J.



Limit Switch (9)

A new explosion-proof heavy duty precision limit switch, designed for use on all types of machinery and industrial equipment in explosive gas or vapor-air atmosphere. Listed by Underwriters' Laboratories as suitable for hazardous locations of Class I, Group C and D. Designed IMLI-EI, it is made so that user may adjust operating head to any of four horizontal positions. Roller arm assembly may be reversed to position the actuator roller on either side of actuator arm. Roller arm is field adjustable to operate clockwise, counter-clockwise, or in both directions. Actuator arm assembly is adjustable through 360° to any of 870 positive lock positions at intervals of 0.4°. Switch case measures 6 inches by 2⅛ inches by 1-61/64 inches.

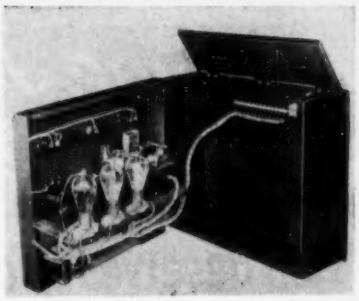
Micro Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.



Conduit Elbows (10)

Corner pull-in conduit elbows in 1¼-in., 1½-in. and 2-in. sizes have been announced. They are ideal for space saving, machine wiring, etc. and should bring new installation ease and speed on many applications. They are cadmium plated, made of malleable iron, and accurately machined to assure perfect threads and alignment.

Gedney Electric Co., 1270 Sixth Avenue, New York, N. Y.



Rectifier (11)

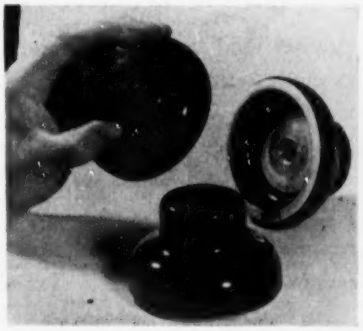
A new, three phase, 25 amp rectifier, housed in a square, sheet metal, hammerloid finished cabinet. Cabinet measures 22 inches wide and high, and approximately 8 inches deep. On its face are ammeter and voltmeter and switch. Ventilation is through louvres in top. It is pierced for wall mounting in case shelf mounting or floor mounting is not desired. It can be used to operate dc motors, magnetic chucks, magnetic separators and the like. It can be operated as a battery charger.

Electronic Rectifier Co., Rochester, N. Y.

Insulating Varnish (12)

A new high heat-resistant insulating varnish, called Irvington No. 180 will operate at temperatures of 365° F. (180° C). It has a clear color, oil and moisture resistance, with a dry dielectric strength of 2100 volts per mil.

Irvington Varnish & Insulator Co., Irvington, N. J.



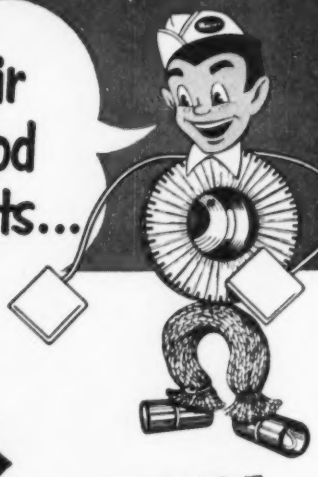
Insulator (13)

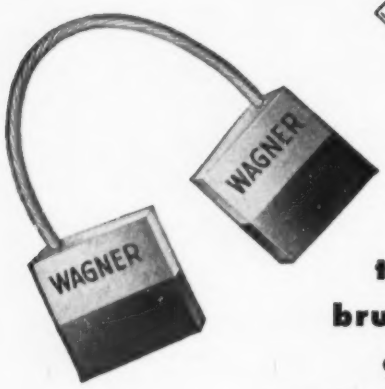
This new bolt-end insulator is designed to shield the projecting ends of transformer support bolts. When transformer housings are grounded, the through bolts which support them are consequently at ground potential. Such bolts, projecting through cross-arms or poles, constitute a hazard to linemen who may not recognize them as being grounded. Insulator consists of a porcelain shape, chocolate glazed, with a recess in the center of which is a metal thimble, with a ⅝-inch-11 thread.

Lapp Insulator Co., Inc., LeRoy, New York.

Genuine Joe says:

every good repair job deserves good replacement parts...





BE SURE

that replacement brushes are the same grade of carbon as the original brushes!

There *is* a difference in motor brushes. Replacement brushes must be the correct grade of carbon, as well as the correct size, in order to assure "like new" motor performance.

Brushes used in Wagner Motors are the finest obtainable, carefully selected for the particular motor in which they are used. Be sure to replace them with *identical,* genuine Wagner brushes. They're easy to identify because the name WAGNER is stamped on every brush.

WRITE FOR: *Wagner's Motor Parts Catalog MU-40 and for Fast-Moving Parts Bulletin MU-122. Every motor repair shop needs these helps.*

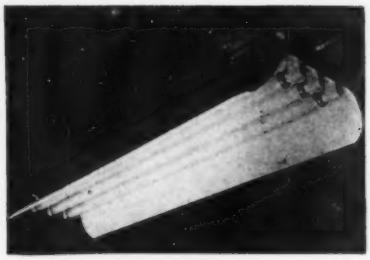
Wagner Electric Corporation EST 1891

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

MOTORS · BEARINGS · STANDARD ROTORS
BRUSHES · CAPACITORS · COMMUTATORS

OVER 750 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

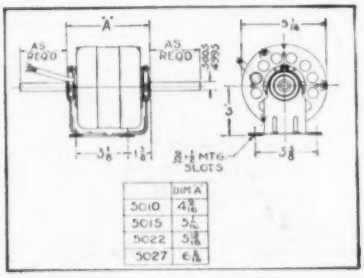
MS53-4



Fluorescent Lighting (14)

Wacline fluorescent lighting ballasts and fixtures for operation across 480 volt power lines, designed especially for industrial applications. They are engineered for surface, suspended, or recessed applications. Units are designed for mounting end to end in even multiples of two feet and may be used with or without reflectors. Fixtures are preferably supplied with ballasts having corrective power factor. As most industrial loads involve motors having lagging power factor, the addition of lighting loads with leading power factor ballasts can usually be achieved without increase in wire sizes. Stroboscopic effects are minimized in 3-phase lighting systems by connecting individual lamps across different phases. This is possible since each lamp has a separate ballast.

Wac Engineering Company, 35 South St. Clair St., Dayton 2, Ohio.



Motor (15)

New model 4000 motor specifically designed for fan duty in air conditioners, window fans and other similar applications. It is a 6-pole shaded pole motor with drawn steel housing, self-aligning bearings and is offered as a two-speed or single speed motor, available with or without rubber mounts and resilient base and overload protection. Speeds of 1050 rpm with lower second speed of approximately 800 rpm are standard. Ratings are 1/15 hp, 1/12 hp, 1/10 hp and 1/8 hp.

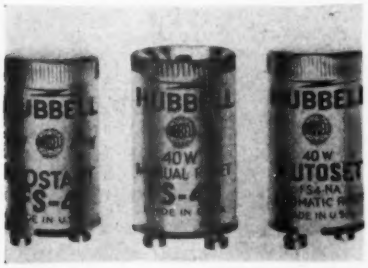
Electric Motor Corporation Division of Howard Industries, Inc., Racine, Wis.

Wire-wrapping Tool (16)

A wire-wrapping tool produces without the use of solder, a gas-tight joint between terminal lug and connecting wire in assembly of electrical, electronic and electro-mechanical equipments. The tool is a hand-held gun, either air or elec-

trically operated, that has a rotating spindle with an axial opening that receives the wire terminal and a smaller axial opening into which the skinned end of connecting wire is inserted. Gun rotates its spindle, which shoots the wire around the terminal in a tight helix, making a firm mechanical metal-to-metal joint. Automatic positioning of spindle facilitates loading; controlled tension makes uniform warps.

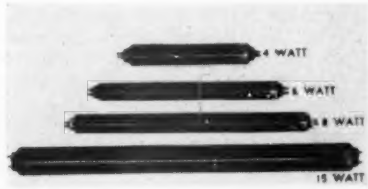
Western Electric Company, Inc., 195 Broadway, New York 7, N. Y.



Starters (17)

A complete new line of fluorescent lamp starters, named "Jackrabbit". The four types are: Neostart, a glow discharge starter, suitable for use under any normal operating condition; the manual reset, a protective type starter which de-activates any worn out or defective lamp, thus protecting the fluorescent system; the Autoset, designed for use under "hard to start" conditions involving high humidity, low line voltage, etc. Also available are Thermostart starters for dc applications.

Harvey Hubbell, Inc., Bridgeport, Conn.

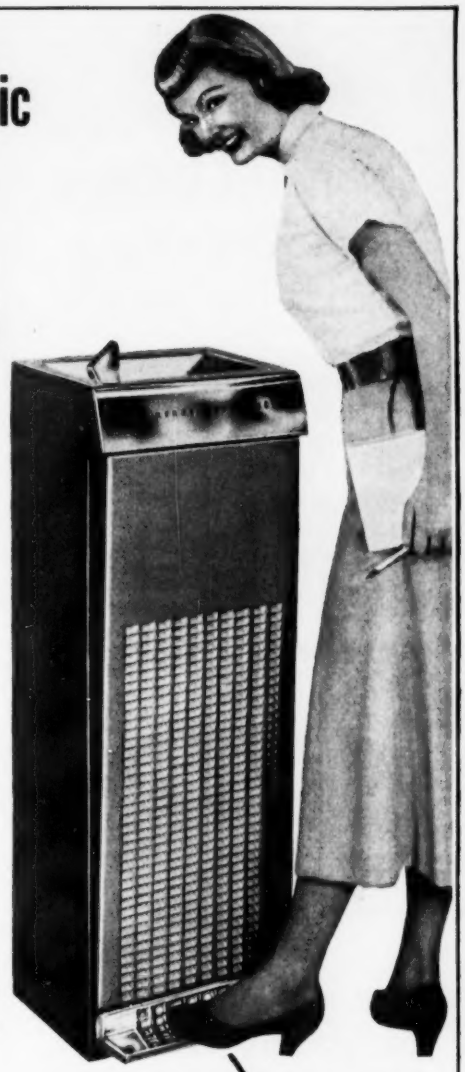


Blacklight Lamps (18)

Raymaster blacklight lamps are low pressure mercury arcs. They furnish a source of long wave ultraviolet or "blacklight" filtered to remove most of the visible light. These lamps have this principal application: to excite manufactured fluorescent pigments and materials, and also natural fluorescent materials used in many industrial and professional fields —paints, dyes, oil, aircraft, textiles, minerals, laundries, art, criminology, marine, soil and food analysis and inspection. Comparisons, determinations and detections can be solved with blacklight lamps. Energy peak is close to 3600 Angstrom units. Lamps require auxiliary operating equipment. Available in 4, 6, 8, 15 and 30 watt.

George E. Gates & Co., Inc., Franklin Square, L. I., N. Y.

General Electric Announces a really NEW Water Cooler!



You've never seen a water cooler like this before—styled to fit the smartest showroom, yet rugged enough to take hard use in a plant. It's the all-new Diamond Anniversary G-E Water Cooler sparkling with far-ahead features.

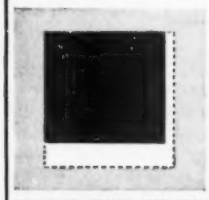
NEW COMPACTNESS, requires 30% less floor space.

NEW SERVICING EASE, all adjustments made through snap-off front.

NEW COOLING DEPENDABILITY because it features the famous G-E compressor—as used in G-E household refrigerators (over 3,500,000 in service 10 years or longer).

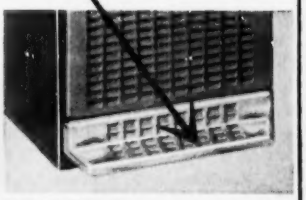
NO SQUIRT, NO SPLASH, NO SPILL, thanks to G-E automatic air-pressure vent, deep-dish basin, and non-squirt bubbler.

LEARN HOW YOU CAN EARN extra income without extra overhead by selling the G-E Water Cooler line. Send in the coupon, or contact your G-E wholesaler.



COMPACT! TAKES 30% LESS FLOOR SPACE without sacrificing capacity or efficiency.

CLEAN AND SANITARY. Electro-polished anti-splash top and gray hammered finish resist soiling.



EASY TO USE. Unit is activated by giant-width foot pedal, directly linked to valve. No groping, even in the dark.

GENERAL ELECTRIC

General Electric Company, Air Conditioning Division, Section EC-17, Bloomfield, New Jersey

Rush full particulars on the G-E Water Cooler Plan.

NAME..... COMPANY.....

ADDRESS.....

CITY..... COUNTY..... STATE.....

7 Years of Outstanding Service Reported for Slo-Speed

Slo-Speeds have given outstanding service on casting tumblers which place rapidly alternating and opposing heavy loads on the gears. Slo-Speeds also operate in the presence of fine sand and iron dust and in spite of this unusual abuse, Slo-Speeds have been in operation 5 days per week since 1944 with no attention except lubrication, reports H. L. Romine, Foundry Engineer, Renfrow Gray Iron Foundry, Los Angeles.

STERLING SLO-SPEED

GIVES YOU THE ONE BEST LOW SPEED AND

gives uninterrupted service — carries heavy overhung loads — provides versatile mounting and flexibility in arrangement of machinery — saves valuable space — provides greater safety — costs less to install and use. An indispensable source of low speed power for:

Agitators	Dryers	Presses
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Blowers	Kilns	Screens
Conveyors	Mills	Tumblers
Cookers	Mixers	Etc., etc.

20-page illustrated catalog... Sterling Speed-Trol, Slo-Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. I-C-416

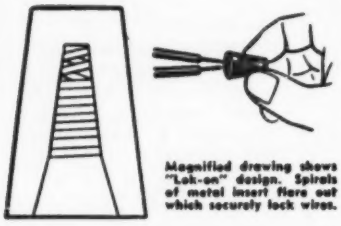
STERLING ELECTRIC MOTORS

Plants: New York City 51; Chicago, Illinois Los Angeles 22; Hamilton, Canada; Santiago, Chile Offices and distributors in all principal cities

Instrument (19)

A new Universal five range hand tachometer, Type "UO" with improved slip coupling overspeed device. Overspeed device prevents damage to Tachometer mechanism due to accidental overspeeding on wrong range. Each unit is individually calibrated with hand-drawn scales. They are direct reading in rpm. Tachometer works independently of direction of rotation, can be used in any position and is not affected by temperature variations. Type "UO" available in four models such as 30-12,000 rpm, 45-18,000 rpm, 60-24,000 rpm and 120-48,000 rpm. Each have five ranges of about 7-inch scale length or a total of about 35 inches of aggregate scale length.

Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.



Magnified drawing shows "Lok-on" design. Spirals of metal insert flare out which securely lock wires.

Connector (20)

A screw-on type connector, called "Lok-on", consisting of a Bakelite shell and cone shaped metal spring insert. It is approved by Underwriters' Laboratories, Inc., for joining 1 No. 18 with 1 No. 16, 2 or 3 No. 18, and 2 No. 16 wires, solid, stranded or a mixture of both. As connector is screwed on, wires are drawn through the small end of the cone into the lock where they are wedged in.

Holub Industries, Inc., Sycamore, Ill.

Smoke Detector (21)

A two-stage smoke detection unit, which can discriminate between light and serious smoke conditions. Included in this unit is a fire detector which will immediately operate a parallel circuit in case a fire or overheat condition occurs that does not generate enough smoke to operate the smoke detector. The smoke detection unit consists of a light source and an electric-eye receiver. Unit operates when receiver detects a drop in light intensity. Depending on the amount of light absorbed, the receiver triggers one of two stages. This two-stage detection distinguishes between small and large smoke concentrations. The first stage sets off a local plant alarm, so that plant personnel can investigate the trouble and take action before a serious hazard develops. Incorporated into the two-stage smoke detector is a separate fire detector unit, which responds to heat. Called Detect-A-Fire, it operates an entirely independent circuit to an alarm or extinguishing system, so as to provide an immediate response in the event that a smokeless fire should occur. It can be preset to operate between 140 and 725 F.

Cardox Corp. 307 North Michigan Ave., Chicago 1, Ill.

Carbon Brush (22)

A new and improved carbon brush design called the Multiflex brush. A Neoprene pad holds multiple brush units together. Pad allows greater brush flexibility to eliminate uneven brush wear and to improve brush life. Brushes are tailor-made and need not be cut down to fit commutator.

Helwig Carbon Products Co., 2540 No. 30th St., Milwaukee, Wis.

Ceilings (23)

New GrateLite, the plastic louver-diffuser, is used to form a completely illuminated ceiling for stores and offices. The light is diffused through GrateLite's $\frac{3}{8}$-in. translucent cubical facets which provide 45° lamp shielding. It fills the room with low brightness diffused illumination and distributes soft light evenly from wall to wall. Eyes are protected from glare and remain comfortable regardless of position in the room. Ceilings are easily installed in any commercial interior. GrateLite sections rest on inverted "T" rails which are suspended from the overhead. Open construction keeps maintenance at a minimum. When cleaning is required, panels are removed, washed and destaticized in two minutes.

Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.

Now...set fastening studs wherever they're needed
MODEL 450 REMINGTON STUD DRIVER
Here's new economy . . . new speed in construction fastening! The Remington Stud Driver joins wood or steel sections to concrete or steel surfaces in seconds . . . easily sets as high as 5 studs a minute. Powerful 32 caliber charges drive studs arrow-straight. The tool's light weight—only 5½ pounds—simplifies handling wherever studs are needed.
New guards for specific uses now make the self-powered Remington Stud Driver more versatile than ever. These attachments take all the guesswork out of stud location . . . assure fast, accurate fastening for every job. Illustrated are just 4 of these special guards. For full information about the complete line and about the Remington Stud Driver, send the coupon below.
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1 to 3,000 KVA up to 15,000 Volts to meet Individual Requirements
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- ELECTRIC FURNACE
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New MARCUS "Type C" general purpose lighting transformers, for installation either indoors or outdoors, are available for immediate delivery in sizes from 1 to 15 KVA, single phase and three phase. The full lighting line is available NOW, from stock, in sizes from 1 to 50 KVA, single and three phase, up to 600 volts. All contain Class B hi-dielectric, hi-heat magnet wire insulated with DuPont's miracle "*Mylar*" polyester film with at least ten times the puncture strength of standard magnet wire.

New MARCUS "Type C" indoor-outdoor lighting transformers are constructed with electrically welded sheet steel case. Scientifically placed vents provide completely weatherproof ventilation. Self-contained wiring compartment means faster-than-ever installation.

Write for price list

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MARCUS
TRANSFORMER CO., Inc.
HILLSIDE 5, NEW JERSEY

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY

Alarm **(24)**

A new "self-policing" industrial alarm. The ACS circuit automatically signals the operator if the alarm system becomes inoperative due to failure of any component in system itself. This self-policing, plus compact "plug-in" design of unit, provides immediate replacement while automatically maintaining complete process supervision and protection. Each unit may be used for either normally open or normally closed field conditions, allowing changes in field from NO remote switch to NC remote switch.

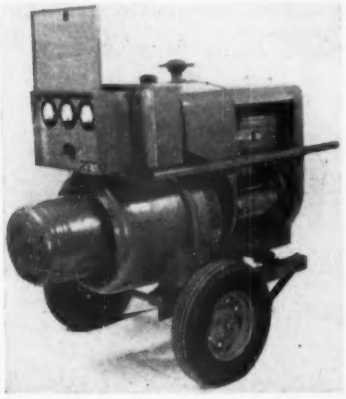
Scam Corporation, 3909 West Irving Park, Chicago 18, Ill.

Load Center **(25)**

The QP Quicklag P load center and service equipment, is designed for homes, offices, stores, commercial buildings, schools, hotels and institutions of all kinds. A feature of the new equipment is the QP Quicklag P circuit breaker, which provides quick-make and quick-break operation, either manually or automatically. On harmless overloads, the thermal-magnetic trip automatically trips circuit breaker with handle position indicating circuit in trouble. On severe overloads or short circuits, magnetic trip speeds opening of circuit breaker. Once cause of trouble is removed, service is restored by moving handle to "off" position and then to "on". Units are of "base assembly design". Four "panel base assemblies" in four sizes of enclosures, plus a stock of individually packaged single and double pole (individual trip) circuit breakers will fit almost any job requirement. Base assembly can be designed to provide for present electrical needs, with knockout spaces for addition of future circuits. All circuit breakers are interchangeable. Capacities of circuit breakers

are: 15, 20, 30, 40 and 50 amps, 120 or 120-208 volts ac, 4 to 20 poles; 115-250 volts, 3-wire single phase, or 120-208 volts, 4-wire three-phase mains with lugs only. Also available with main circuit breaker.

Frank Adam Electric Company, 3654 Windsor Place, St. Louis 13, Mo.



Generator (26)

A new model generator consisting of a 5 kw ac generator which generates 60 cycle current at standard voltages of 110/220, single phase or 3 phase, 220/440, 1800 rpm. Unit is of the revolving field type with separate exciter attached. Available with or without automatic voltage regulator. Generator is powered with a 2 cylinder, 4 cycle type air-cooled engine. Available with or without standard 6 volt automatic type starting. Entire unit is mounted on wheels with retractable handles. Engine and generator are housed for outdoor use. Adapted for commercial and industrial applications. Auxiliary hookup equipment is available to permit full automatic standby.

Katolight Corporation, 624 North Front St., Mankato, Minn.

Connector (27)

A new Bakelite connector, labeled "Intermediate", of the helical cone spring type. Catalogue No. MA-1-SI, the UL-listed connector has a capacity of 2 or 3 No. 12 solid or 4 No. 14 solid wires. Like all DE Wire connectors, it eliminates the need for tape, solder or tools.

Metalectrics, Inc., 677 Broadway, New York 12, N. Y.

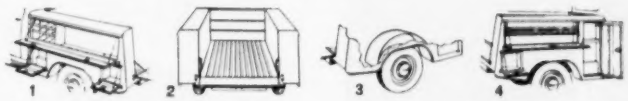
Carries your shop to the job...

the NEW **Service-Master**

ELECTRICAL CONTRACTING SERVICE BODY

Service-Master is designed to speed up your work — styled to reflect the ability of your firm. Its six weathertight compartments include shelves and bins for the tools and parts you'll need on the job.

Whether your chassis is old or new — you'll find it economical to choose *Service-Master* for your next service body.



1. Weathertight, double-panel doors.
2. 48½" wide loading area, with one-piece ribbed steel floor.
3. Fully enclosed wheelhousings.
4. Parts bin with hinged cover and removable dividers.

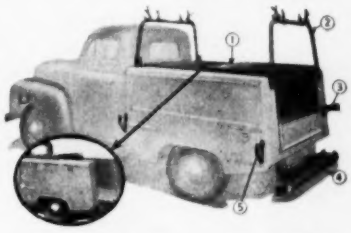
SERVICE-MASTER is Delivered *Ready-for-Work!*

Service-Master sets the pace in service body styling. Compare it with any other make for completeness, design, and advertising value.

◄LOOK FOR THIS NAMEPLATE!

OPTIONAL EQUIPMENT

1. Telescopic steel roof, and endgate with locking handle.
2. Removable rack with adjustable ladder and material brackets.
3. Removable vise bracket with pipe support on head panel.
4. Rear bumper-step.
5. Pipe carrying brackets.



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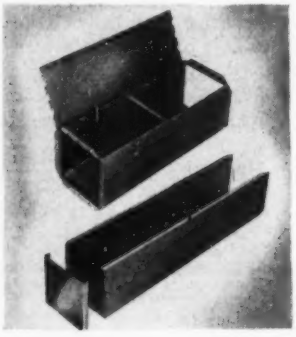
ELECTRICAL FITTINGS CORP.
Dept. C-12
Woodside 77, New York

Foot Switch (28)

New Type MA foot switch on which internal switching action has been improved by using SPDT "du-op" limit switch. Access to internal switch terminals is facilitated by removing front end of two-piece top casting. Actuating treadle built into top of foot switch requires light foot pressure. Cable enters switch through front by means of a BX connector or a rubber grommet. Mounting is by means of holes in housing.

General Control Co., Boston 34, Mass.



Square Wireways (29)

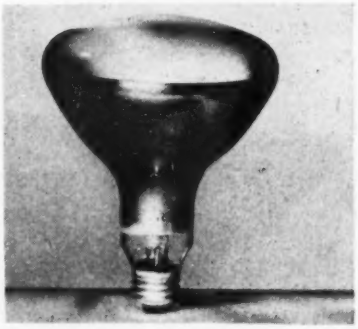
New 8-inch square wireways will carry up to 15-500 CMF conductors. Available in two types, flanged hinged cover and flangeless screw cover. Hinged cover wireway has a flange at each end allowing access to wireway interior. Available auxiliary fittings include 90° elbow and pull boxes, "T" fittings, closing plates, trough collars, bracket and drop hangers. Flangeless screw cover wireway is designed for use with meter boards service boards, loadside switches, etc. Auxiliary fittings include closing plates and "U" connectors. Both types are made in 1, 2, 3, 4 and 5 foot lengths, and are provided with conveniently spaced knockouts in side and back to accommodate ½-in., ¾-in., 1-in. and 1¼-in. conduit. Also available without knockouts.

Keystone Manufacturing Co., 23328 Sherwood Ave., Center Line, Mich.

Light Control (30)

The wallbox dimmer is an adjustable transformer. It is designed to replace the light switch in a wall, to provide complete lighting control from blackout to full brightness. By turning the knob, the desired amount of light can be selected. It controls any number of lamps up to 360 watts at 120 volts. It controls by converting watts. Installation of dimmer is simple in new construction or old structures. It is wired into new or existing circuits. A switch at the blackout position shuts off the entire circuit. Safety is assured by a fuse and thermal overload protector. The external knob and faceplate are styled to harmonize with any decor.

Superior Electric Co., Bristol, Conn.



Reflector Color Lamps (31)

Six new incandescent reflector color lamp bulbs include four which produce basic colors—red, green, yellow and blue—and two blue-white and pink tints. They may be mixed or diluted with white light to produce virtually any color in the rainbow. Rated at 150 watts, they do not require color caps, having permanent color filters baked on five-inch faces. Tints provide either a warm or cool atmosphere. Lamps also are suitable for lighting of small stages. All colors can be used for general and accent lighting in theatres, restaurants, lounges and cocktail rooms. Out of doors, reflector lamps have applications at motels, service stations and drive-ins. Also possibilities for garden lighting, Christmas lighting effects, and outdoor parties. As they are subject to thermal shock, lamps should be protected from rain or snow.

General Electric Co., Nela Park, Cleveland 12, Ohio.

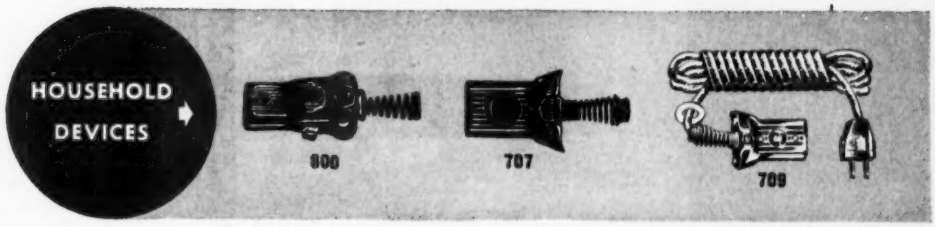
Coupler (32)

A small coupling device permits the multiple use of TV antenna. It can also be used in combinations of two, three and four units for the operation of as many receivers from one antenna. It is designed for use with antennas having 300-ohm ribbon-type transmission line. Transmission line connections are made by placing lines in prepared grooves in body of coupler. Attachment of screw-type caps to top and bottom of coupler forces lines against built-in contact points which pierce insulation and make contact with the wires.

RCA Victor, Division of Radio Corporation of America, Camden, N. J.

RODALE

it's the name to reckon with in electrical wiring devices and TURN-TYTE interlocking connectors. Rodale offers wholesalers throughout the nation *the most complete independent line* for hardware and household uses, as well as industrial requirements. Over a quarter-century of skill, know-how, and superior judgment goes into every item bearing the time-honored, job-tested name of RODALE . . . whether it's a wiring device for normal use or the famous shockproof, strainproof, safety-proven TURN-TYTE connectors for industry. Where applicable, all Rodale products are manufactured under Underwriters' standards, according to Federal specifications.



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EMMAUS, PENNSYLVANIA

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Warehouses in Chicago and Los Angeles
Representatives in all principal cities

FULLMAN **Latrobe**
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ADJUSTABLE WATERTIGHT FLOOR BOXES

NON-ADJUSTABLE WATERTIGHT FLOOR BOXES

ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4

NOZZLES AND FLOOR BOX ACCESSORIES

FLOOR JUNCTION BOXES

UTILITY OUTLETS

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PIPE AND CONDUIT HANGERS

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CABLE CLIPS

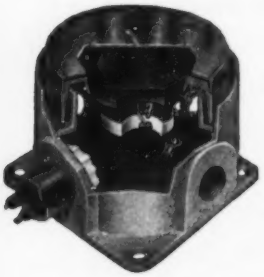
STAPLES

FISH WIRE

FULLMAN MANUFACTURING CO. QUALITY LATROBE SUPREMACY LATROBE, PA.

DEPENDABLE

Clean and compactly designed to cut installation time to the bone and give smooth, trouble-free service "Latrobe" Products give a full measure of value.



Adjustable Watertight Floor Boxes

All "Latrobe" Adjustable Watertight Floor Boxes are now equipped with a positive electrical bonding wire between the exposed flush parts which make them completely fire-proof.

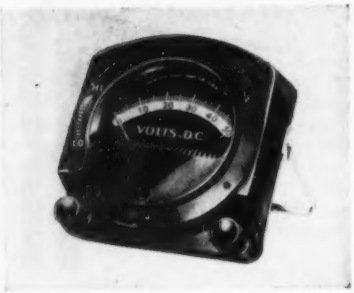
Pipe and Conduit Hanger

Convenient and dependable for hanging pipe or conduit ½", ¾", and 1" to steel beams up to ⅜" thick. Permits pipe to run at any angle to the beam.

Fullman Manufacturing Co.

1209-1215 JEFFERSON STREET

LATROBE, PA.



Instrument (33)

New multi-dialer is a multi-scale instrument which exposes only one scale to view at a time. At the same time, it automatically switches the appropriate internal or external circuitry associated with that scale. It incorporates the Marion ruggedized movement. Available with five self-contained ranges in volts, milliamperes, microamperes and amperes —or custom-engineered to specific equipment. It may be used as a panel instrument (mounting to standard JAN 3½-in. dimensions) or as a complete self-contained portable instrument for field or laboratory use.

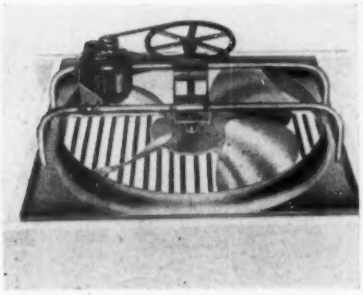
Marion Electrical Instrument Co., Manchester, N. H.

Intercom System (34)

A new multiple handset intercom system for confidential two-way intercom where people are within earshot of one end of the conversation. A handset station, in the exposed area, is used to call a central point to obtain information, issue instructions, place orders. User lifts handset from its cradle, depresses built-in talk-button, and speaks in a quiet tone. His voice, amplified to required volume level, is heard at the central location, where confidential conversation is not necessary. Employee here answers call through a staff station from across the room. His reply is heard only by the person using the handset station to originate the call. Where central location is in a large area, a two-way trumpet-type staff station may be used. Any number of handset stations may be used, permitting personnel to call and talk con-

fidentially with a central location. Handset station consists of black handset 9 1/16-in. long, 3-in. wide, 3-in. deep, with vertical black handset hanger 3 1/16-in. wide, 2½-in. deep, 3¾-in. high. Central amplifier is relay-controlled and housed in a ventilated metal case 9¼-in. long, 6-in. wide and 6½-in. high. Operates on 50-60 cycle, ac only. Staff station is housed in a metal cabinet 6-in. wide, 6½-in. high and 3½-in. deep at base. May be table, wall or ceiling mounted. Trumpet-type staff station, constructed of aluminum, is 10-in. in diameter, 10-in. long with equivalent of a 19-in. air column.

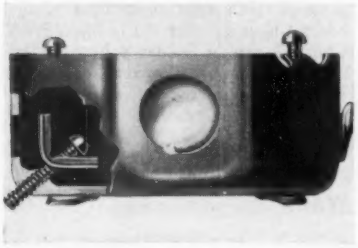
Executone, Inc., 415 Lexington Ave., New York 17, N. Y.



Attic Fans (35)

A new DeLuxe line of attic and industrial fans. Available in both vertical and horizontal discharge models. Each DeLuxe model has a corresponding Standard line model in both vertical and horizontal types in all eight models from 24 inch to 48 inch. The sizes and specifications of the Deluxe and Standard lines are identical with the exception of the sealed-ball-bearing motors which are not used in the Standard line. The Deluxe model never requires lubrication.

The Fan Division, Murray Co. of Texas, Inc., 185 Harris St., N. W., Atlanta, Ga.



Outlet Boxes (36)

A new design feature available only on 4-in. octagon outlet boxes. Threaded holes are now extruded from the nominal metal thickness of .067-in. up to a depth of .171-in, which more than doubles the number of threads formerly available. This provides increased strength, and eliminates any possibility of stripping threads either on clamping screw or in outlet box.

Keystone Manufacturing Co., 23328 Sherwood Ave., Center Line, Mich.

Plan Now
FOR SAFE* ALL-ELECTRIC ELECTROMODE HEAT

HARD-TO-HEAT AREAS
FACTORIES
OFFICES
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PUMP HOUSES
METER HOUSES
WATCHMAN HOUSES
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MORE PROFIT FOR YOU

- QUICK, EASY TO INSTALL
- MINIMUM MAINTENANCE
- 100% EFFICIENT
- USER SATISFACTION

***SAFE** Only Electromode has the completely sealed-in, cast-aluminum heating element. No danger of fire, shock or burn. Built-in safety switch prevents overheating.

***ECONOMICAL** All current entering the unit is converted into heat. There is no heat loss en route, like there is with long steam pipe runs. This system cannot freeze. The heating element will not rust, corrode or deteriorate. For utmost economy, can be thermostatically controlled.

COMBINATION PORTABLE and SUSPENSION type models, 1500 to 7500 watts (5,122 to 25,613 btu). Adjustable louvers permit directing heat into working zone. Model AN-30A illustrated.

SUSPENSION TYPE MODELS available from 10,000 to 45,000 watts (34,150 to 153,675 btu). Adjustable louvers permit directing heat into working zone. Model 14-10 illustrated.

EXPLOSION-PROOF HEATERS for heating hazardous areas subject to explosion. In three sizes: 2000, 4000, 6000 watts (6830 to 20490 btu). Model CX-2 illustrated.

AUTOMATIC WALL-TYPE HEATER with Down-Flo principle distributes clean, healthful, fan-circulated heat at floor level. Available from 1500 to 4000 watts. Model WA illustrated.

Approved by Underwriters' Laboratories

ELECTROMODE CORPORATION
Dept. EC-73, 45 Crouch Street, Rochester 3, N. Y.

Please send us your FREE Electric Heating File, containing specifications, illustrations, installations, prices and how to figure electric space heating.

We are interested in ☐ Electromode Industrial Heaters ☐ Electromode Home and Office Heaters ☐ Electromode Explosion-Proof Heaters

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Address .....

City .....Zone....State.....

New!

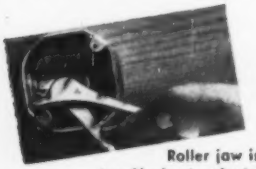
ANGLE LOCKNUT PLIERS

BY

UTICA®

No. 750-8"

- tightens locknuts in outlet boxes
- removes burrs from conduit or pipe
- cuts and skins rubber-covered wire



1 TO TIGHTEN LOCKNUT

Roller jaw is placed in center of locknut and rotates freely. Fixed jaw twists and tightens by catching locknut lugs.

2 TO CUT AND STRIP INSULATED WIRE

Wire is cut by placing in base of jaw. Insulation is stripped by crushing between roller and tip of jaw where spacing is designed for No. 14 to No. 8 wire.

3 TO REMOVE BURRS FROM OUTSIDE OF CONDUIT

Roller jaw is placed inside pipe. Scraping edge catches burrs on the outside.

TO REMOVE BURRS FROM INSIDE OF CONDUIT

Roller jaw is placed on outside of pipe. Scraping edge works on inside.

Your tool dealer has the new UTICA Angle Locknut Pliers or can get it for you.

U◇TI◇CA®

DROP FORGE AND TOOL CORPORATION

UTICA 4 NEW YORK

IT PAYS TO BUY QUALITY TOOLS

and the world's best tools are made in U.S.A.

Motor Auxiliary (37)

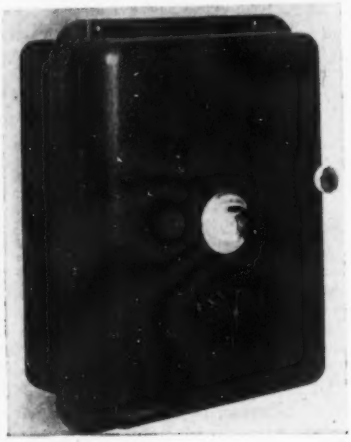
Motor-X is a motor auxiliary for operating a three phase squirrel cage induction motor from a single phase power supply. It permits the use of three phase motors in areas where three phase power is not available. Particularly useful for temporary, isolated, "rush" and emergency installations, units are used with wye, not with delta, connected motors. Standard units, available in 1 hp to 10 hp ratings, operate a 200 volt, 60 cycle motor from 230 volt, 60 cycle, single phase lighting circuit. Class I units, for use with motors which start unloaded, are designed for minimum starting current. Class II units develop approximately 200% starting torque at approximately 15% higher starting current than Class I units. Both units develop approximately 200% breakdown torque. All units include branch circuit and motor running overcurrent protection, a disconnecting means and motor controller. For remote or automatic starting or no voltage release a magnetic contactor, and for reversing operation a drum switch or reversing contactor may be installed between motor and Motor-X unit.

Motor-X Products Company, P. O. Box 26, Cincinnati 8, Ohio.

Motors (38)

Horsepower ratings of totally-enclosed and explosion-proof vertical pump motors have been increased to 75 hp. Available with either hollow shaft or solid shaft construction, motors are designed for powering turbine pumps in refineries, sewage disposal plants, dangerous, dusty or dirty locations. Designed to comply with Underwriters' specifications for Class I—Group D, highly inflammable gases and volatile liquids and Class II —Groups F and G, for combustible dusts. Totally-enclosed vertical motors are suited for service in plants or locations where non-explosive conditions prevail, for protection against non-combustible dust, dirt, moisture, abrasives and corrosive-forming drippings. Both types are double-enclosed with built-in fan. Features are adjustable hollowshaft, reverse protection clutch, die-cast rotor, aluminum canopy cap, dynamic balancing, asbestos-protected windings, and lubriflush lubrication.

U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.



Enclosure (39)

Flush type enclosures for the 26 Series flame failure safeguard controls. These units are included in the Fireye flame safeguard systems FP-2 and FP-4 for both automatic and manually fired burners of all types. FP-4 system is used for manual or semi-automatic fired gas, oil or coal burners and FP-2 is used for full automatic fired burners. They are both supplied with dust tight flush mounted control housings finished in black crinkle. Controls can be mounted in combustion control power panel with all control wiring concealed in rear of panel.

Combustion Control Corp. 718 Beacon St., Boston 15, Mass.

Wire (40)

"Sil-X" wire was designed for temperature extremes. It retains its flexibility at high and low temperatures, is resistant to flex cracking, has insulation resistance at high temperatures, and retains its physical properties. Insulation on Sil-X wire is fungus resistant and will not become brittle after long and continuous exposure to outdoor weathering at high and low temperatures. It has been approved by Underwriters Laboratories for use in lighting fixtures at temperatures up to 200°C, and for use as radio and television hookup at tempertures up to 150°C. It is recommended for use in oil and gas fired furnace con-

foremost in contemporary lighting

PRESCOLITE®

There is a Prescolite for any commercial or residential installation. Easy to install, **Easier to sell!** Exclusive features, pre-wired units. Wide range colors, styles and finishes — unit packing, easy to stock and reship.

Write for complete new catalogs to: Prescolite 2229 Fourth Street, Berkeley 10, California.

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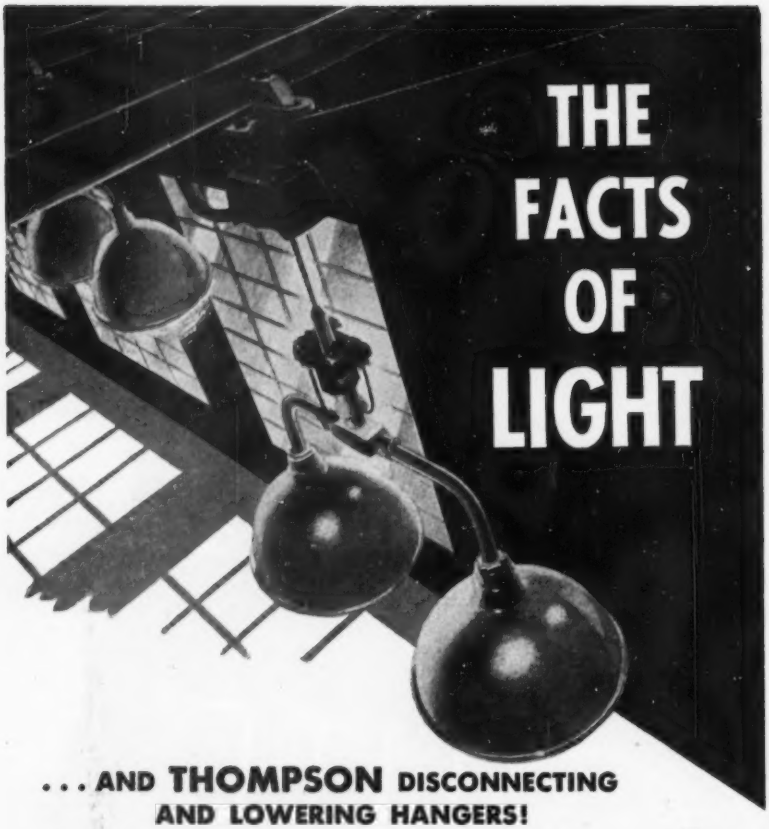

. . . AND THOMPSON DISCONNECTING AND LOWERING HANGERS!

FACT NO. 1: Around-the-clock plant efficiency requires regular planned maintenance of lighting equipment.

FACT NO. 2: Only high-bay lights suspended from Thompson disconnecting and lowering hangers can be serviced easily and safely . . . at floor level.

FACT NO. 3: Plants equipped with Thompson hangers are setting records in safety. No ladders, scaffolding or hazardous practices are needed for luminaire maintenance . . . one man quickly cleans and relamps lowered fixture while standing on the floor. Electrical dangers are eliminated by Thompson hangers because lowered fixtures are "dead".

FACT NO. 4: Thompson disconnecting and lowering hangers cut maintenance costs by saving man hours . . . reducing accidents. One man can clean four times as many Thompson hanger-equipped lights per hour as two men servicing fixed-position lights by means of ladders or scaffolds.

To learn the complete facts of light, write today for the new illustrated BULLETIN TH-52.

THE THOMPSON ELECTRIC CO.

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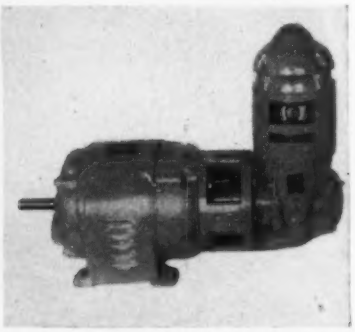
trol equipment. It is flexible at 400°F and at —104° F. has low power factor, resists corona, low dielectric constant; acid-alkali-oil resistant, insulation approaching mica.

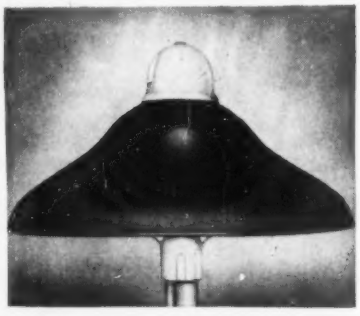
Essex Wire Corp., Fort Wayne, Ind.



Multimotor Unit (14)

A packaged unit, consisting of a horizontal motor, a footless right angle worm gear motor and an over-running clutch. Designed for dry-cleaning type machinery, unit has take-off speeds of 1750 and 100 rpm. Other combinations of speeds are available in ratios as great as 100:1. By means of a special bracket, right angle Syncrogear is assembled to horizontal Uniclosed motor in factory, simplifying final installation onto driven machine.

U. S. Electrical Motors, Inc., Terminal Annex, Los Angeles 54, Calif.



WEATHERPROOF LUMINAIRE for service station islands. It is 24 inches in diameter and features removable side plates on both sides of socket housing. Outlet at top of housing is designed to accommodate a variety of lampholders or assemblies. Made by Philadelphia Electrical and Mfg. Co., 1200 W. 31st St., Philadelphia 21, Pa.

Product Briefs

(43) The Smith Power Transmission Co., Cleveland, Ohio, has developed the Flexoid silent block **couplings**. . . . (44) Cam-Stat, Inc., Los Angeles, Calif., has announced a new combination fan and limit **control.**

(45) Manco Mfg. Co., Bradley, Ill., has announced a new Guillotine mobile

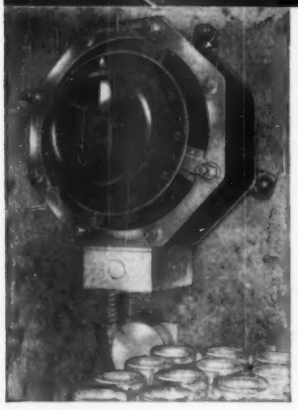
BIG RESULTS

in added Patron Appeal

at low cost

with POWERSTAT

Light Dimming Equipment



at the MARQUES HOUSE in HARTFORD CONNECTICUT

A pleasant, appropriate atmosphere is a must for the enjoyment of good food. And light — properly controlled — is one of the most effective means of creating an atmosphere that pleases patrons and keeps them coming back again and again.

At the attractive Marques House, a single, inexpensive, easily installed POWERSTAT Dimmer permits dimming, brightening or blending of light smoothly and without flicker to create the desired effect.

However large, small, simple or complex your lighting problem . . . there is a POWERSTAT Dimmer just right to bring you Big Results at Low Cost. For more complete information, use the handy coupon below to send for fully descriptive literature on POWERSTAT Light Dimming Equipment. The Superior Electric Company is pleased to help you select the POWERSTAT Dimmer most suited to your specific needs.

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BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC COMPANY, 6073 DEMERS AVENUE, BRISTOL, CONNECTICUT

Please send me descriptive literature on POWERSTAT Light Dimming Equipment.

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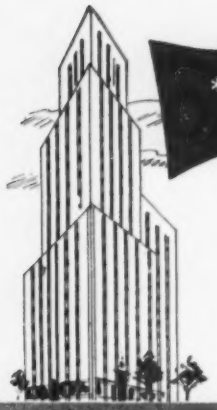
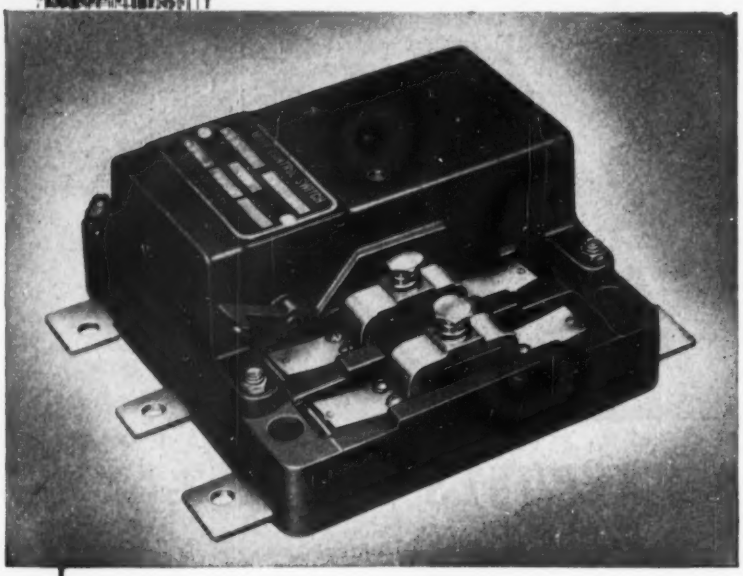


***A CONTROL MUST FOR HIGH BAY LIGHTING**

...instant disconnect of lighting and power feeders from remote panel

***THE SWITCH TO PROVIDE THIS SERVICE!**

...the ASCO Remote Control Switch now made in capacities up to 1000 amperes



Are you laying out the electrical circuits for a large building—a factory—a hangar—an auditorium—an institution? Buildings with extensive high-lighted working bays?

Instant remote disconnect of lights and power circuits is a "must", if both safety and economy are objectives.

Remote controls for instant disconnect protect workers and machinery. They eliminate multiple heavy feeder lines thus saving on installation costs.

The ASCO Line of Remote Control Switches, similar to the switch illustrated, now ranges up to 1000 amperes in capacity. Write us about your requirements.

Electromagnetic Controls For All Industry

We also manufacture a complete line of Solenoid Operated Valves for Automatic and Remote Control of Liquids and Gases.

ASCO Electro-Magnetic CONTROLS

Automatic Switch Co.

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hydraulic **bar and channel shear**. . . . (46) Brulin **solvent degreaser** has a high safety factor and fast-drying action. Made by Brulin & Co., Inc., Indianapolis, Ind. . . . (47) A portable electric **jig saw** that will do the work of a jig saw, sabre saw, keyhole saw plus most band saw operations has been announced by Black & Decker Mfg. Co., Towson, Md.

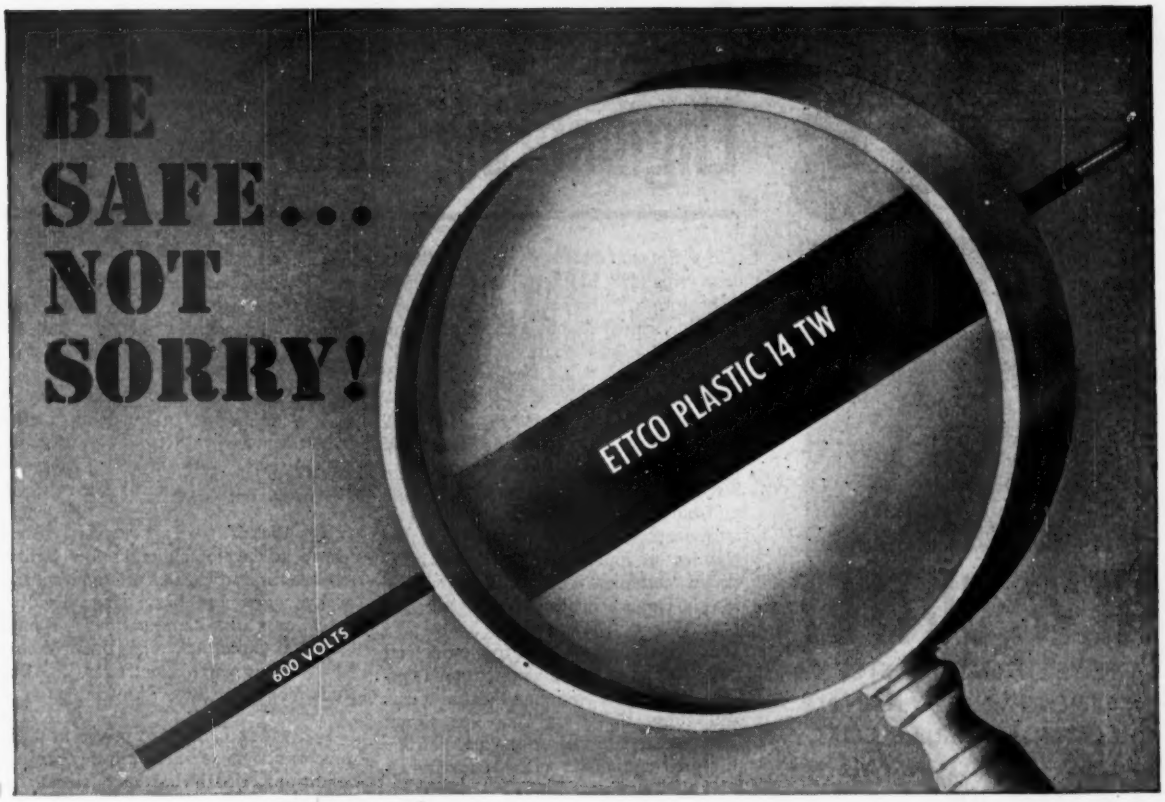
(48) A cam-action **saw attachment** has been developed by the E-Z Way Tool Co., Barrington, Ill., to convert the rotary power of an electric drill to a thrust-action saw. . . . (49) Model R-1 Midget wheel-type **wire stripper** was specially designed for stripping of film insulation from very fine magnet wires. Manufactured by Rush Wire Stripper Division, The Eraser Co., Inc., Syracuse, N. Y. . . . (50) Columbia Cable & Electric Corp., Brooklyn, N. Y., has announced the production of a new, improved non-metallic sheathed **cable**, called Columbia-Flex.

(51) A redesigned line of high-sensitivity portable **galvanometers**, useful in both laboratory and factory for measuring low values of current or voltage, has been announced by General Electric Co., Schenectady, N. Y. . . . (52) Industrial Instruments, Inc., Cedar Grove, N. J., has developed a new high voltage breakdown **tester**, Model P-7-20. . . . (53) A new clamp type **Utilite** is being produced by the Steber Manufacturing Co., Broadview, Ill. It accommodates PAR-38 and R-40 spot and flood lamps, sun, heat and photoflood lamps.

(54) A new tool called Safe-T-Matic **nail driver** is being manufactured by Safety Nail Driver Corp., Clifton, N. J. . . . (55) Induction Motors Corp., Woodside, N. Y., has announced that its 29 frame **motor** can now be supplied with a special centrifugal switch for use in control applications in electronic equipment. . . . (56) Aerosol **spray** called "Rust-Cutter", loosens rusted nuts, bolts and studs. It is manufactured by James R. Kearney Corp., St. Louis, Mo.

(57) The May Engineering Co., North Hollywood, Calif., has introduced a machine for **counting** and **marking** at the same time. . . . (58) An electric **timer** that turns home appliances on and off automatically at the desired time day after day, without resetting, is now available from International Register Co., Chicago, Ill. . . . (59) A plug in type **humidity control** that automatically regulates the operation of portable home dehumidifiers has been introduced by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

(60) Industrial Products Company, Philadelphia, Pa., has announced a new "Red Rider" pole **truck flag holder** for use on pole trucks of electric service and telephone companies.



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(newest member of the Ettco family!)

- small diameter Thermoplastic Wire resists severe exposure!
- lubricated for easy pulling!
- easiest, cleanest stripping ever!
- saves initial and maintenance costs . . . installation time!
- laboratory tested and inspected!
- packaged in handy cartons!

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- Service Entrance Cable

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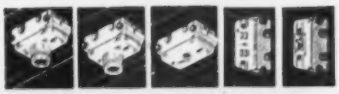
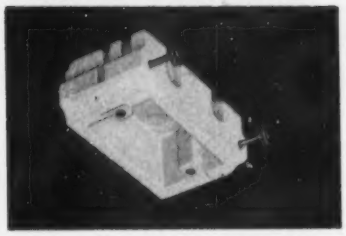
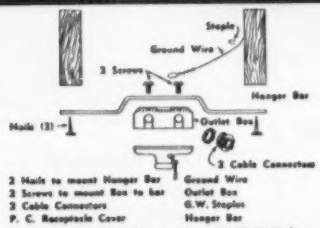




NEW OUTLET

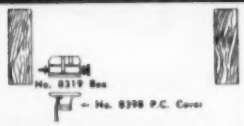
- FEWER ITEMS TO STOCK.
- FEWER ITEMS TO HANDLE.
- LOWER MATERIAL COST.
- LESS TIME TO INSTALL.
- A SAFER JOB.

ELIMINATE ALL THIS



11 THINGS. Count 'em, ELEVEN! !

SIMPLIFY TO THIS



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1 No. 8398 P.C. Receptacle Cover
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NO Ground Wires
NO G.W. Staples

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Catalogs, Bulletins and Engineering Data

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(62) DOOR CONTROLS for automatic operation of doors used in business and industry; description of pushbutton, pull cord, floor-switch and photo-electric controls with sketches showing mechanics of operation. 16-page illustrated catalog. The Stanley Works, Magic Door Division.

(63) SOUND SYSTEMS for industrial uses; explanation of sound fundamentals, glossary of sound and signal terms and suggestions for choosing signal installations; specifications and listings of signal equipment suitable for industrial plants, mines, outdoor and hazardous locations. Signal Guide Book. Benjamin Electric Mfg Co.

(64) PROTECTIVE RELAYING of power apparatus; the broad principles of modern practice; information on types of relays used with generators, transformers and transmission lines; procedures used in evaluating power apparatus and system characteristics to determine proper application and settings of relays; complete listing of available relays. 72-page illustrated booklet. General Electric Co.

(65) FLEXIBLE WIRING CONDUIT for protection of machine tool and industrial equipment wiring in wet locations; illustrations of actual installations. description and specifications. Two 4-page bulletins. American Brass Co.

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(67) INCANDESCENT LIGHTING FIXTURES for ceiling and wall; desk and floor lamps; photos, diagrams and dimensions. 39-page catalog. Spear Lighting Fixture Mfg. Co.

(68) LIGHTING EQUIPMENT designed for gardens and residential outdoor play areas; photos, descriptions and applications data. 4-page bulletin. Steber Mfg. Co.

(69) POWER TRANSFORMERS, forced-oil-air-cooled type; discussion of cooling systems with large diagram showing directed oil flow. Two-color, 4-page bulletin. General Electric Co.

(70) WELDING ELECTRODES; recent technical developments in low hydrogen electrode field; effects and control of hydrogen and basic slag; welding procedures and applications. 8-page technical bulletin: "The Facts About Low Hydrogen Electrodes." Alloy Rods Co.

(71) STREET LIGHTING program planning in six steps: determining present conditions, classifying each street, establishing lighting needs, establishing an order of preference, selecting equipment, and making the layout. Tables on luminaire spacing and distribution; section on lighting of curves, intersections, railroad crossings and alleys. 27-page booklet. Westinghouse Electric Corp.

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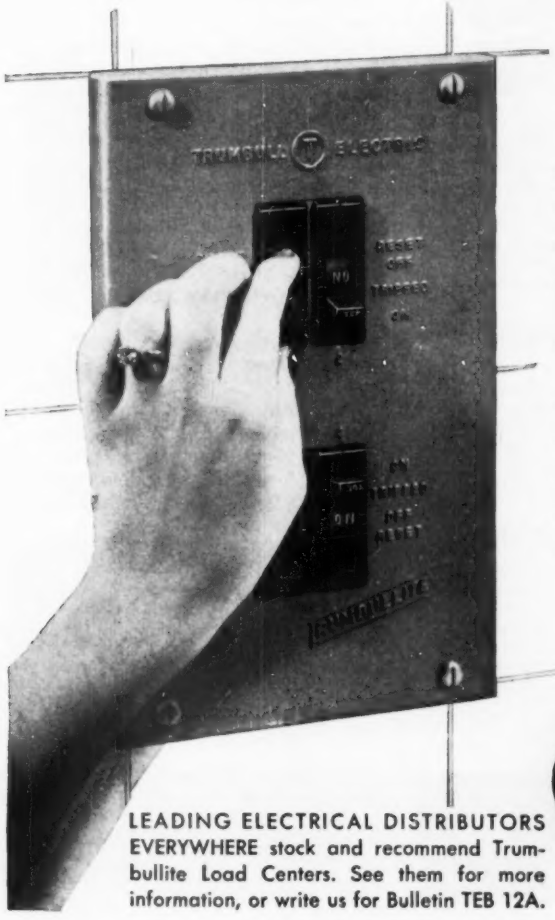

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- Two-pole operation of adjacent breakers, through extension handles.
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- Primarily for residential and commercial applications.
- No external disconnect needed with 6 circuits or less.
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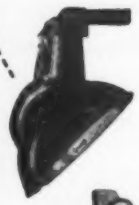

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600 volts ac and up to 2 hp at 230 volts dc; magnetic available in three basic forms; remote control, local control and selector switch control from 110 to 550 volts ac up to 400 hp. Two 4-page leaflets. Federal Electric Products Co.

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(78) TEXTILE MOTORS and combination motor starters for driving spinning frames; general design features and specific advantages of textile motors of fan-cooled and water-cooled construction. Two-color illustrated 4-page bulletin. General Electric Co.

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(83) WOUND ROTOR MOTORS from ½ to 1,000 hp; principles of operation, performance curves and characteristics, construction, methods of manufacture, and enclosures available. Bulletin No. 1300. Louis Allis Co.

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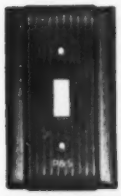

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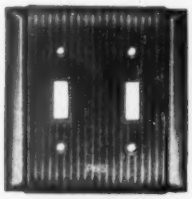

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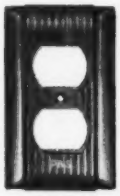

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THE SWITCH THAT REMEMBERS AND LETS YOU FORGET

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(84) VARIABLE SPEED MOTORS; illustrations of all types showing mechanical features, remote controls; outline of factors improving production. Bulletin No. 1797. U. S. Electrical Motors Inc.

(85) NEMA MOTOR STANDARDS, comparing old frame dimensions of ac motors from 1 to 30 hp with new frame dimensions passed by NEMA on May 19, 1953. Motors covered include open-type polyphase, single-phase, wound-rotor, totally-enclosed fan-cooled, foot-mounted, flange-mounted and general purpose. 8-page bulletin. General Electric Co.

(86) WIRING REELS in single units or ganged for handling, storing or displaying wire and cable; description, photographs and dimensions. 8-page bulletin with price list. Hykon Mfg. Co.

(87) ELECTRONIC TRANSFORMER for general industrial, radio, TV and signalling uses; illustrated with photographs, tables, characteristic curves, dimensioned sketches and circuit diagrams. 28-page bulletin. Triad Transformer Corp.

(88) WELDING ELECTRODES guide; chemical analysis, mechanical properties, procedure for welding of over 30 different electrodes; electrode comparison chart. 50-page pocket-size booklet. Air Reduction Co.

(89) WIRING DATA and weight computer; solves building wire, power cable, flexible cord, fixture and motor wiring problems. Six and a half by three inches, slide-rule type. Hatfield Wire & Cable.

(90) METALLIC RECTIFIER power supplies for electroplating and similar processes; operation and applications of manually-controlled and automatically regulated units; charts and diagrams showing ratings and dimensions. Two-color illustrated 16-page booklet. General Electric Co.

(91) MOTOR AND FAN BASES designed to isolate vibration and noise; illustrations, specifications and case histories of installations. 4 page catalog. The Korfund Co.

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(1) FASTEN WIRES WITH "SCOTCHLOK"

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...the super-thin plastic tape that's a perfect companion to "Scotchlok." Start as shown, bring forward between the wires and wrap until tape extends ½-inch beyond small end. Fold extension over and wind back toward bell end. Easy! Order a supply of "Scotchlok" and "Scotch" 33 today!

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Reader's Quiz

Electrolytic Condensers

QUESTION K23—Please explain the difference between electrolytic condensers for direct current circuits and those for ac motors.—P.S.

ANSWER TO K23—Electrolytic capacitors which consist of basic structural members, that is, anode member, electrolyte and container or electrolyte contacting cathode foil, are designated as polarized or dc types. Such capacitors are intended for service with unidirectional potentials. Electrolytic capacitors which consist of two anode foils or members immersed into an electrolyte which is common to both are designed as non-polarized or ac types. The non-polarized type is generally confined to the dry electrolytic type of mechanical construction, and such capacitors are used for service where only ac potentials are applied. The non-polarized type of electrolytic capacitor, in effect, is the same as two polarized or dc types, series connected back to back; that is, the two negative terminals are connected together. In such an arrangement the electrical capacity of one anode member is in series with the capacity of the other. It can be seen from this that the total anode surface area of a non-polarized capacitor of a given voltage and capacity rating is four times that required for a polarized or dc type of the same voltage and capacity rating.—O.C.

ANSWER TO K23—An electrolytic condenser required the use of a chemical, usually a compound of aluminum, to form one plate of the condenser. In an ordinary condenser, both plates are metallic sheets, but in the electrolytic only one is a metallic sheet. In order to form this second chemical plate, a polarizing dc voltage must be applied. As the chemical plate is very close to the actual metallic plate, the capacitance of the unit is very great for the physical size.

When the electrolytic is placed on ac, it is found that the unit behaves like a rectifier. When the current is one way, the electrolytic plate is formed and a condenser action takes place. when the current is the other way, no chemical action takes place and the current flows directly through. In order to circumvent this action, we take two units and place them back to back. Therefore when the current is going one way, the first unit conducts and the second is a capacitor; when the current goes the other way the second unit conducts and the first is a capacitor.

There are other small differences owing to the strong pulsations in current which cause heating unless the units are designed for this service; but the basic difference is as outlined above.—H.H.S.

Horsepower Rating Of Speed Reducer

QUESTION L23—Can a speed reducer be used on a lower input speed than rated on the nameplate, with the same horsepower rating as given on the nameplate?—E.S.H.

ANSWER TO L23—The horsepower rating of a speed reducer must be reduced proportionally if the input speed is lower than rated on the nameplate. A glance at the following simplified formula for designing gearing should make this obvious.

Horsepower Rating = S × R × speed = in which,

S = Maximum allowable fibre stress on the gear teeth,

R = Radius of the gear.

Since both the maximum stress S and the radius R are unchanged, if you alter the speed, the rated horsepower will change in direct proportion. It is also apparent that if you attempt to transmit the rated horsepower at lower than rated speed, you are proportionally increasing the stress on the gear teeth, which will cause rapid wear and possible failure. Some speed reducers have a shearing-pin, the purpose of which is to prevent just such overloading and failure. The shearing-pins are readily replaced and the speed reducer is then as good as new—S.O.H.

ANSWER TO L23—The answer is no if you expect the same life, factor of safety, etc. A decrease in speed does not permit an increase in torque nor does a decrease in torque permit an increase in speed. If your speed reduction is slight, you can still probably get the same horsepower output without damage, since the increase in torque would also be slight.

Other factors which enter into the question are whether the load is applied smoothly or with shock, and whether the load is continuous or intermittent.—P.S.

Reconnecting A 20-hp Motor

QUESTION M23—Is it possible to reconnect a 20 hp, 900 rpm, 220 volt, 3 phase motor to make a 20 hp, 1800 rpm, 440 volt, 3 phase motor?—E.H.

ANSWER TO M23—It is possible to reconnect a 20 hp 900 rpm 220 volts 3 phase to 1800, 440 volts 3 phase. In the first place, the 220 volt connection has got to be either 2 circuit Wye or a two circuit Delta to make an equal change to 440 volts single Wye or single Delta and regroup from 8 pole 900 rpm to 4 pole 1800 rpm. The horsepower at 1800 rpm will be higher—35 to 38 horsepower.—J.J.A.

ANSWER TO M23—This change cannot be made as proposed for this reason: Since a 900 rpm, 60 cycle motor has four poles, the span of the coils must be approximately one fourth of the circumference of the stator. An 1800 rpm motor has only two poles so the coil span is approximately one half the stator circumference. Since the coils are not the same dimensions for the two speeds, the change of speed cannot be made by reconnecting.

A new set of coils would be required. The voltage change alone could be made with the old coils or the new coils.—E.A.M.

ANSWER TO M23—It is possible to reconnect an 8 pole 220 volt motor for 4 pole operation on 440 volt, but it is equally true that this is generally undesirable. In fact, motors not specifically designed for changing pole combinations and speeds give only fair performance when their characteristics are altered by reconnection.

Assuming that the 8 pole motor is connected 4 parallel star for 220 volt

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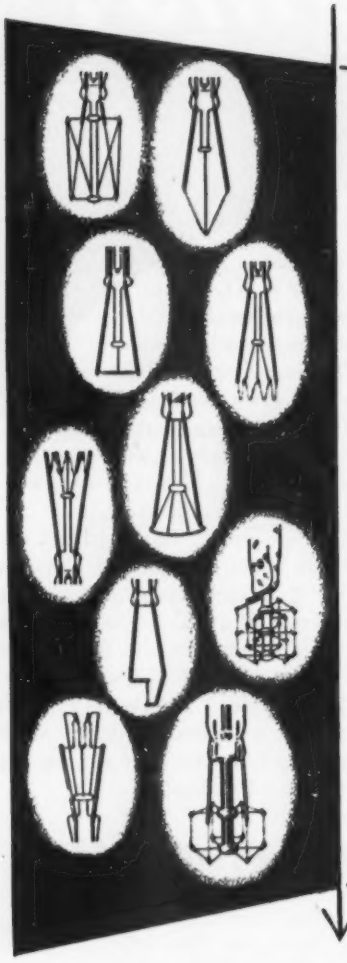
Filamentary facts about *Champion Lamps*



FACTS OF LIGHT

For a 60 watt filament you start with a straight piece of tungsten wire 21 inches long, drawn to a diameter equal to just 2/3rds the thickness of this page. When this wire has been coiled 1200 times around a molybdenum mandrel, drawn with a tolerance 1/30th the thickness of this page, its length becomes 3.4 inches. For higher concentration of heat and, hence, more light, the coil is coiled again to a double coil only 5/8ths inch in length.

After the molybdenum mandrel has been dissolved by acid, the length and uniformity of each pure tungsten coil must pass relentless inspection. Microscopic variations can seriously impair lamp life. Weight is tested on equipment that can weigh a pencil mark.

Working with wire so fine as to be almost invisible, to tolerances measured in millionths, Champion experts produce filaments that cannot be surpassed in performance. Starting at the very beginning of the lamp industry, Champion has taken advantage of every scientific advancement and quality control technique to produce Lamps for industry that provide unsurpassed service and value.

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Pictured are a few basic filament arrangements for Champion Incandescent Lamps, each designed for specific service needs.

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operation, it is possible to reconnect to 4 pole series delta diagram for operation on a 440 volt line. This takes into account the change in chord factor when reconnected to 4 pole characteristics and change in voltage from 220 to 440 volts. Or, if the 8 pole rating is connected 8 parallel star, it can be connected 2 parallel delta for 4 pole operation at 440 volts.

The above outlines the only two possibilities for reconnecting a 220 volt-8 pole rating for 440 volt—4 pole characteristics. Much information along this line is contained in the text "Armature Winding and Repair" by Braymer.—E.E.S.

Motor Torque High vs Normal

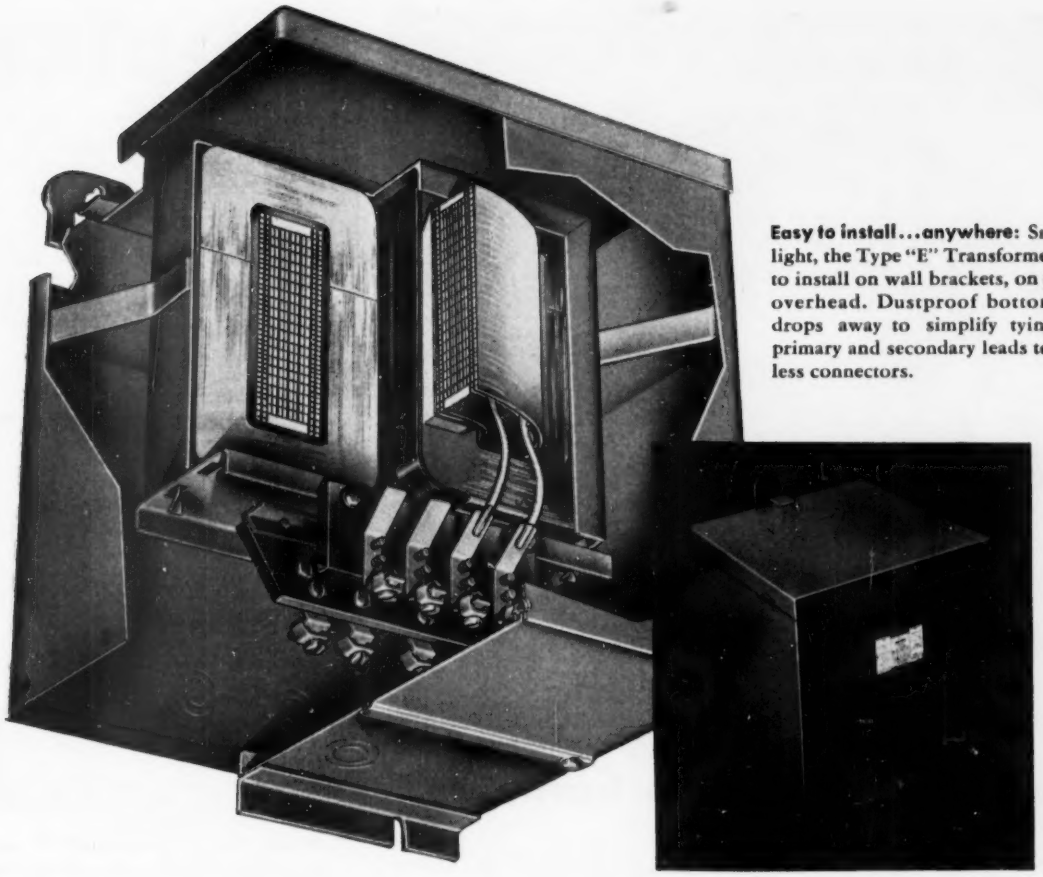
QUESTION N23—We have two grinders, each powered by a motor of a different make. Both motors are 25 hp, 220 volts, 3 phase, 60 cycle, 69 amps and 705 rpm. On machine No. 1 the motor has a high starting torque and stops quickly when plugged. On machine No. 2 the motor takes longer to stop and start, but it can carry a much larger load at full speed. What could account for this? Is there any way of increasing the load carrying capacity of the motor on machine No. 1?—S.R.U.

ANSWER TO N23—Motors can be designed to have different starting and running torques, depending upon the resistance of the squirrel cage winding. The stopping torque obtained in plugging will be a certain percentage of the starting torque of the motor, depending upon the amount of resistance that is inserted in the secondary circuit. Since the first motor has a high starting torque, it will naturally have a fast stopping torque in the reverse direction. Short of changing the rotor, there is nothing that can be done about this as this is basic to the machine.—H.H.S.

ANSWER TO N23—Starting and breakdown torque in an induction motor is a function of rotor reactance and resistance. Increasing reactance and resistance will increase starting torque and decrease breakdown torque (which determines the load a motor can carry at rated speed).

Since these depend upon the design of the rotor, and would be almost impossible to alter in a squirrel cage rotor, it is generally not practical to alter torque and operating characteristics in a motor of this type.—D.H.N.

ANSWER TO N23—The high torque motor will naturally accelerate to full



Easy to install...anywhere: Small and light, the Type "E" Transformer is easy to install on wall brackets, on posts, or overhead. Dustproof bottom panel drops away to simplify tying in of primary and secondary leads to solderless connectors.

NEW totally-enclosed dry-type transformers ...safe, economical for dusty areas!

Here's a problem that the new Westinghouse Type "E" was designed for:

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Since the Type "E" is a totally-enclosed and non-ventilated dry-type transformer, it is suitable for all but the most hazardous or explosive conditions. Through the use of Class H insulation, it is small and light . . . easy to install anywhere.

You'll find Westinghouse Dry-Type Transformers offer an economical answer to your electrical distribution problems. The Type "E" is available from 3 to 22 kva, single phase, 600 volts and below. Further information is contained in booklet B-5812. Get a copy from your Westinghouse representative, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70691

YOU CAN BE SURE...IF IT'S

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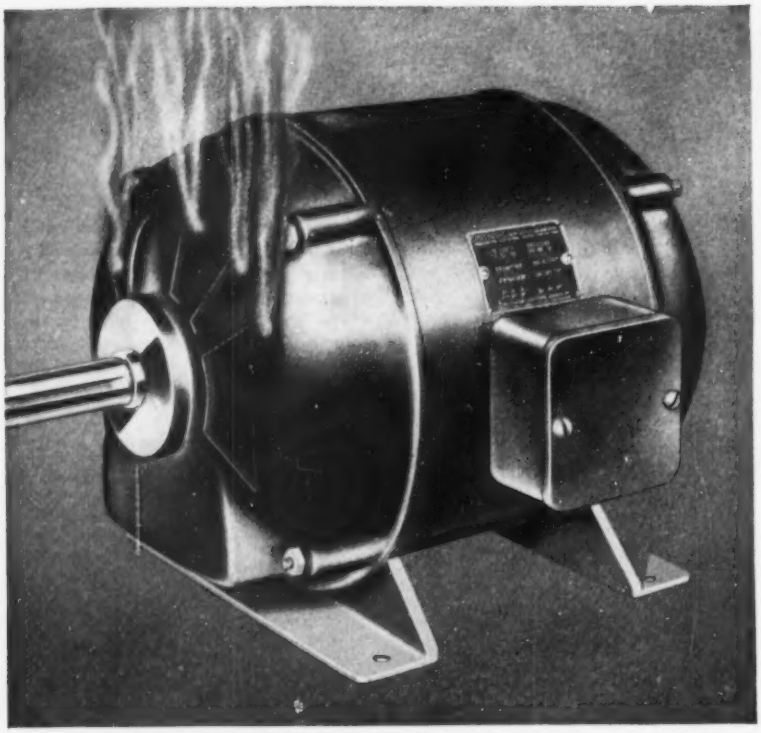


You can avoid motor burnouts

THE temperature surrounding motor protection equipment is an important factor in motor burnouts. In order to prevent nuisance stoppages in hot weather, the rating of protective equipment is often raised. Then, when plant temperature drops, protection is inadequate . . . motors are more subject to burnout.

This explains why an ever-increasing number of plants are standardizing on HEINEMANN Circuit Breakers as manual motor controllers. Set tripping points of HEINEMANN Circuit Breakers *are completely independent of ambient temperature.*

Moreover, HEINEMANN Circuit Breakers provide inverse time delay to permit starting inrush or harmless, temporary overloads . . . yet they provide the fastest circuit interruption available on large overloads, stalled rotors, single-phasing or short circuits.

HEINEMANN Circuit Breakers operate on a hydraulic-magnetic principle. They do not employ thermal elements or heaters. They are available with precise ratings to the motor, and are provided with time delay characteristics especially suited to trouble-free motor protection.

don't use heat
...USE POWER

Send for Bulletin 1410.

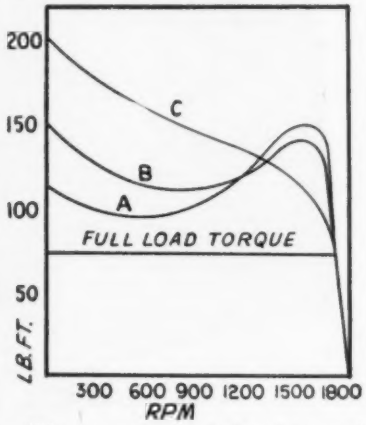
HEINEMANN ELECTRIC CO.
132 PLUM STREET • TRENTON 2, NEW JERSEY

speed in less time than the normal torque motor due to the higher pound feet torque inherent in the motor during the starting period.

The standard normal and high torque motors stocked by manufacturers have torque values to coincide with NEMA figures.

Twenty five horsepower motors running at 1750 rpm have starting torque 150% of full load torque for normal torque motors and 200% for high torque motors. Break down torque 200% for Normal torque motors and 190% for high torque motors.

Curve "A" is a normal torque curve, "B" a high torque curve.



When a motor is designed to meet requirements which differ from the characteristics of a normal torque motor it is necessary to sacrifice some of the performance of the normal torque motor.

If high starting torque is required it is necessary to sacrifice breakdown torque which accounts for the high torque motor not being able to carry the overload carried by the normal torque motor.

When plugged, the high torque motor has more pound feet torque exerted on the rotor to stop it.

The standard motor referred to draws 14.5 amperes per hp starting current. Curve "C" represents a motor about which I was consulted. The power company limitations were such that the starting current was to be not greater than 8 amperes per hp. That the motor possess high torque was also a requirement.

The curve clearly shows that the motor would stand no overload without a marked decrease in rpm and hence a decrease in capacity which was capable of being delivered by the driven unit.

No doubt the high torque motor has a double squirrel cage rotor which would have to be a single squirrel cage to lower the torque in starting and increase the breakdown torque.—B.A.S.

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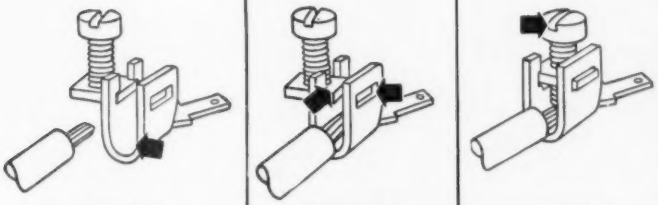
THESE BRYANT DEVICES are designed to cut your wiring costs . . . save time . . . make installation more efficient.

New Pressure Terminals* for 50 ampere, 250 Volt Range and Power Receptacles—No. 3826 and 3846



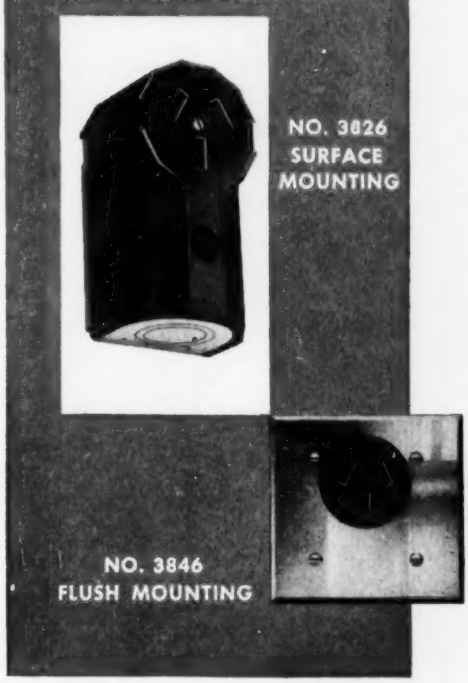
lay wire in open channel

slide pressure screw assembly in opposite slot

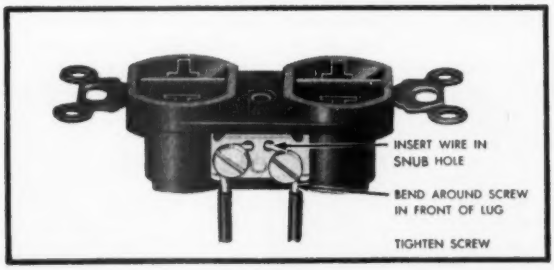
tighten pressure screw

With New pressure terminals:

- there are no loose parts to mislay
- pressure screw assembly is permanently attached to wiring channel
- rounded channel confines wire strands
- assembly terminals cadmium plated for either copper or aluminum wire



New Hole Snub* Wiring on 4832 Convenience Outlet



RATING: 15 Amperes 125 Volt
10 Amperes 250 Volt

ADDITIONAL FEATURES —

- staked terminal screws, backed out
- large head screws permit use of wire up to and including No. 10
- double sided contacts
- "T" slots
- all plastic body available in brown and ivory

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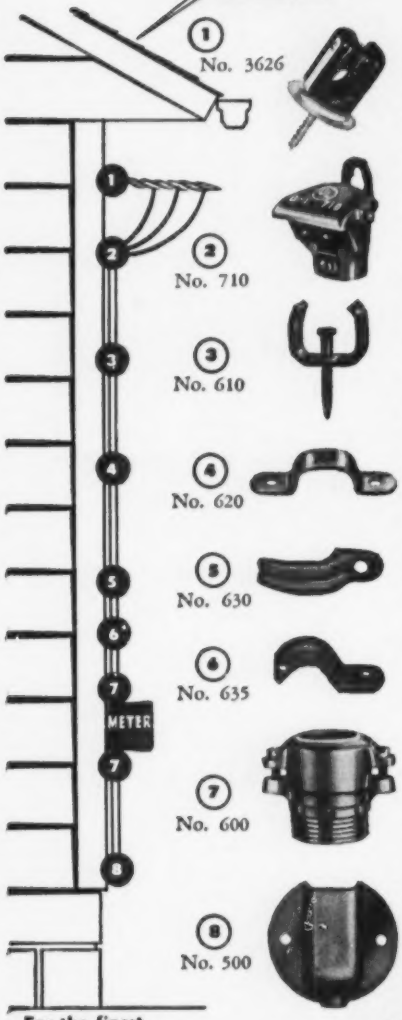

① No. 3626

No. 3626 Wire Holder. Top quality porcelain with round edges; 1" diameter hole. Heavy steel base, 2⅞" diameter. No. 22 square shoulder screw can't slip or turn. All metal galvanized.

② No. 710

No. 710 Service Entrance Cable Fitting. Has cast aluminum main body with separate cover. Heavy steel cable clamp. Large key hole for mounting screw. U. L. Approved.

③ No. 610

No. 610 Steel Cable Strap. Saves time and makes a neater installation. Won't rust. Bends over easily to hold cable firmly. Complete with 1" No. 8 flathead plated wood screws.

④ No. 620

No. 620 Two-Hole Cable Strap.* For service entrance cable. Made from heavy gauge sheet steel — plated to resist rusting. Holes: 7/32".

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No. 630 One-Hole Cable Strap.* For service entrance cable. Made from special malleable alloy cast aluminum. Won't rust. Has heavy shank and ribs to insure good construction. Hole: 7/32".

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No. 635 One-Hole Cable Strap.* For service entrance cable. Made from heavy gauge sheet steel — plated to resist rusting. Hole: 7/32".

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No. 600 Watertite Connector. Clean, easy-running threads and tapered point screws for easy installation. Smooth, non-rusting castings—fitted with live rubber grommet for long-time protection. Sizes: 1" and ¾".

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No. 500 Sill Plate. For all cable sizes. Beautifully formed for good appearance from sheet aluminum. Finished with Duxseal, which won't harden with age. Won't break when screwed in place on rough surface. Complete with two ¾" No. 10 round-head plated wood screws.

*Screws not included.

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DUBUQUE, IOWA

Can you ANSWER these QUESTIONS?

QUESTION X23—On a 7½ hp 220 volt 3 phase motor installation, the contractor was held to close wiring design tolerances due to cost factor. Using motor nameplate rating which was close to Code tables, switch and branch circuit were installed.

When the motor was energized it was found that the actual full load motor current was 150% of the manufacturer's nameplate rating. In this instance would it be the responsibility of the contractor to replace switch and wiring with the proper size?

Is it standard practice to test motors for actual current under full load before installation or can the nameplate rating generally be depended upon to give the actual full load current?—D.H.M.

QUESTION Y23—What is the proper method to restore residual magnetism in a dc generator? I have not seen any standard procedure used. It all seems to be on a hit or miss basis. The "book" says the proper way is to send a dc current of proper direction and magnitude through the field windings. As yet, I have to see a dc generator with polarity markings. Is there any way to determine brush polarity when the generator is not producing?—A.R.

QUESTION Z23—How does glass insulation function when a fault develops in the motor or wiring due to the breakage of the glass insulation at some point? Glass is supposed to become a conductor at very high temperatures. Would not a high temperature at some particular point cause the adjacent glass to become a conductor and cause a spreading short circuit?

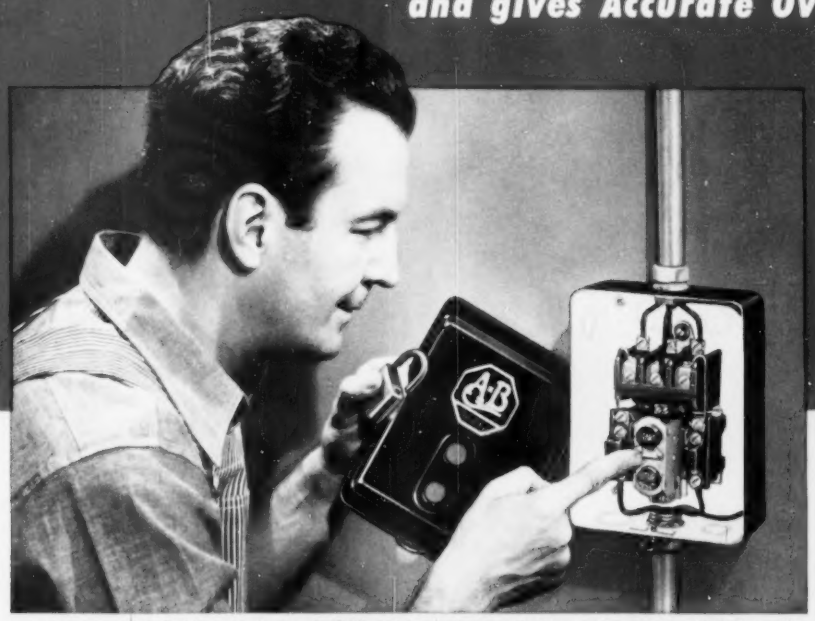
During normal conditions glass is a very good insulator. Will the usual protective devices used on motors and wiring prevent this spreading short circuit?—E.B.

QUESTION A24—Can you tell me why they use two types of connections in three phase electrical motors? Why do they design one for delta and one for star connections? Is there an advantage in one over the other?—R.E.G.

QUESTION B24—What is the tube voltage on a slim line fluorescent light? These tubes are 8 feet long and are plugged into 110 volt outlets.—E.S.H.

PLEASE SEND IN YOUR ANSWERS BY AUGUST 15

A MANUAL MOTOR STARTER
that's Push Button Operated...
and gives Accurate Overload Protection



Maintenance man is locking stop button in OFF position before padlocking cabinet cover. All Bulletin 609 Manual Starters have this safety first feature. It protects man, motor, and machine.

For Single and 3 Phase Motors up to 5 hp, 220 v; 7½ hp, 440-550 v

Bulletin 609 Switch with arc hood raised to show three double break, silver alloy contacts.

Bulletin 609 Starters have a quick make, quick break switch mechanism that is actuated manually with two push buttons. Two accurate overload breakers automatically open the switch in case of sustained overload.

The double break, silver alloy contacts require no cleaning, filing, or dressing. Bonderized pressed steel cabinets resist rust under ordinary plant conditions. For damp or dusty places the special cabinets, shown below, assure long, trouble free life. Millions of Bulletin 609's are in daily use. Write for bulletin.

5-53-M

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BULLETIN 600 MANUAL MOTOR STARTERS

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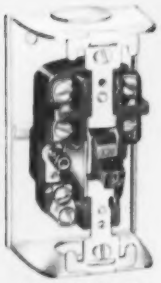


Form 51-52 with cover off

Standard toggle lever switch

Key operated for added safety

Linkage lever switch

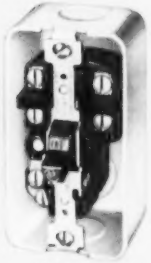
Form 51-52 with pilot light

In watertight enclosure

For hazardous gas locations

Close-up of Bulletin 600 switch mechanism, showing thermal overload breaker. These switches are available with one or two poles.

Fits flush switch box



Fits handy switch box

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with Overload Protection for Motors up to 1 hp

The Bulletin 600 Starting Switch gives overload protection to small a-c and d-c motors on unit heaters, stokers, fans, compressors, and small electric tools. It is a popular and fast selling starting switch.

The overload breaker automatically trips the switch in case of sustained overload. The switch cannot be held closed until the overload on the motor is cleared.

To reset the overload breaker, the switch lever is moved to OFF position. The motor can then be restarted by moving the switch lever to the ON position. Therefore, no time is wasted replacing fuses.

Bulletin 600 Starting Switches are available in many forms of enclosures, a few of which are shown above. For complete data please send for illustrated Bulletin 600, today.

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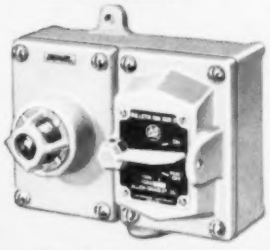
Form 72 unit with selector switch



Form 62 watertight enclosure with pilot light

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BULLETIN 600 STARTING SWITCHES

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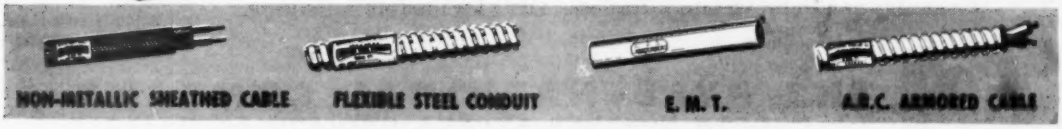

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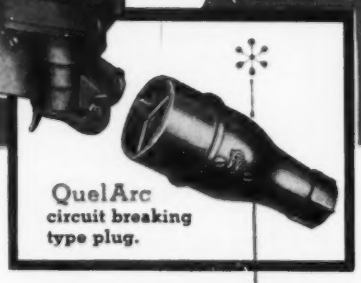
Heavy Duty Safety Switch and Circuit Breaker

RAIN-TIGHT! DUST-TIGHT!

PYLETS



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circuit breaking type plug.

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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Branch Circuit Protection

Q. *Is it a violation of the code to protect 6 or more No. 12 AWG lighting branch circuit conductors in one conduit with 20 ampere circuit breakers?—E.M.D.*

A. There are several ways to look at this question. While the question specifically refers to lighting circuits, let us consider for a moment a power circuiting condition, as shown in Fig. 1.

In this case the minimum size of wire should have a capacity of 125% of the full load current of the motor, viz.,

1.25 × 6.5 or 8.125 amperes

No. 12 wire is more than ample. The maximum size of branch circuit overcurrent protection we will say can be up to 300% of the motor full load current or

3 × 6.5 or 19.5 amperes.

Note 4 of Table I states that the current carrying capacity can only be 80% of the value in Table 1 if 4 to 6 conductors are in the same raceway. In this case the No. 12 wire will, therefore, have to be rated at

.8 × 20 or 16 amperes, each.

However, for the motor circuit they are required to carry only 8½ ampere, so for this condition the answer would be there is no code violation.

Now suppose the circuit is for a set up as shown in Fig. 2.

In this case there are actually four current carrying conductors. The two neutrals, will not normally carry current and in accordance with Note 5 to Table I they are not to be counted in determining the current carrying capacity as required by Note 4. However, even for four conductors, an 80% factor must be used, so that actually these No. 12 wires are only good for 16 amperes.

Since these are 20 ampere branch circuits as stated in Section 2103—i.e., the branch circuit shall be classified in accordance with the maximum permitted rating or setting of the overcurrent device—the No. 12 wires now are inadequate for the circuit. The minimum current carrying capacity of the circuit conductors must be

20/.8 or 25 amperes.

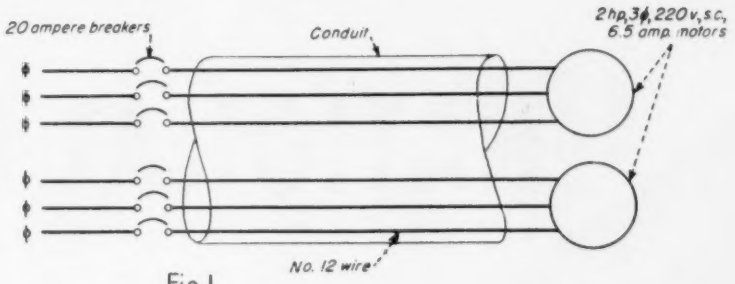

Fig. 1

Fig. 2

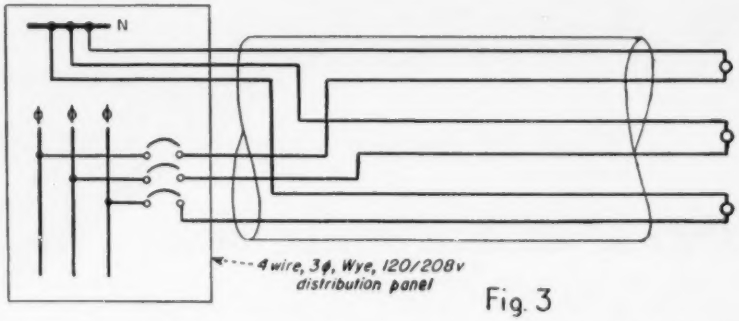

Fig. 3

Table 1 shows a No. 10 type R, RW, etc., or Type RH with an allowable capacity of 30 amperes as the smallest size of wire that could be used in this case.

Another point with reference to this particular installation should be considered. Suppose the branch circuits were derived from a four wire, grounded neutral, three phase, "wye", 120/208 volt system. In other words the two, three wire branch circuits would actually be rated single phase, three wire, 120/208 volts. In this case, for a balanced load on each three wire system the common conductor (the neutral) would actually be carrying full load current. Therefore, in this case, even though there are two neutrals present they must be considered as full current carrying conductors and must be counted as required by Note 4. So for 3 wire "wye", single phase circuits the count would be six conductors. For this particular circuit the reduction factor is the same for 4 or 6 conductors so that the net final result would be the same, i.e. No. 10 wire would be required in either case.

Fig. 3 illustrates another type of installation. Here we have three phase conductors and three neutrals so arranged that under balanced conditions it would seem that the neutrals are carrying no current. Actually, because separate neutrals are being used, each one is carrying current under balanced conditions up to the distribution panelboard neutral bar. So again this must be considered as 6 conductors and the 80% factor must be used as required by Note 4. Actually the practical wir-

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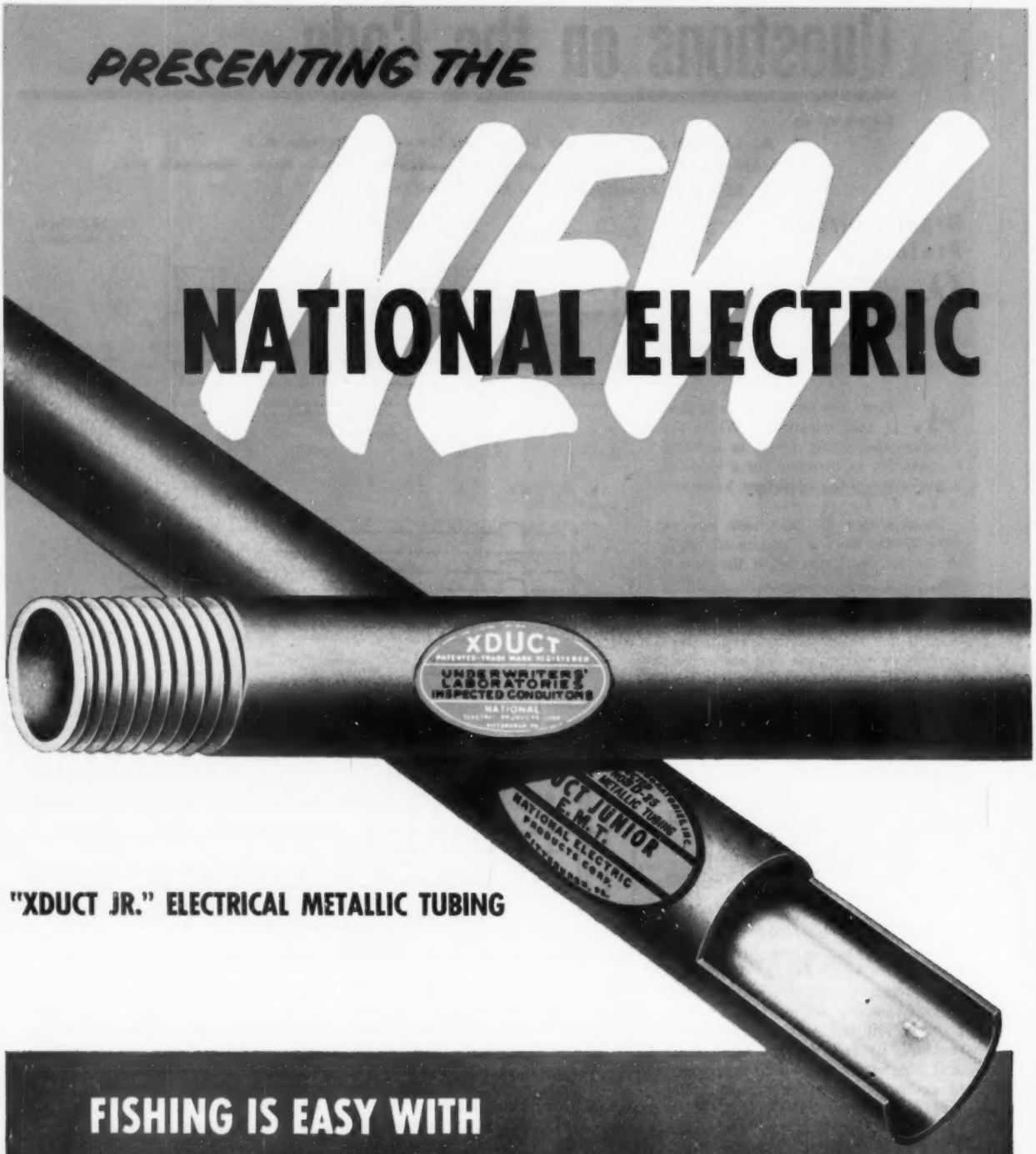

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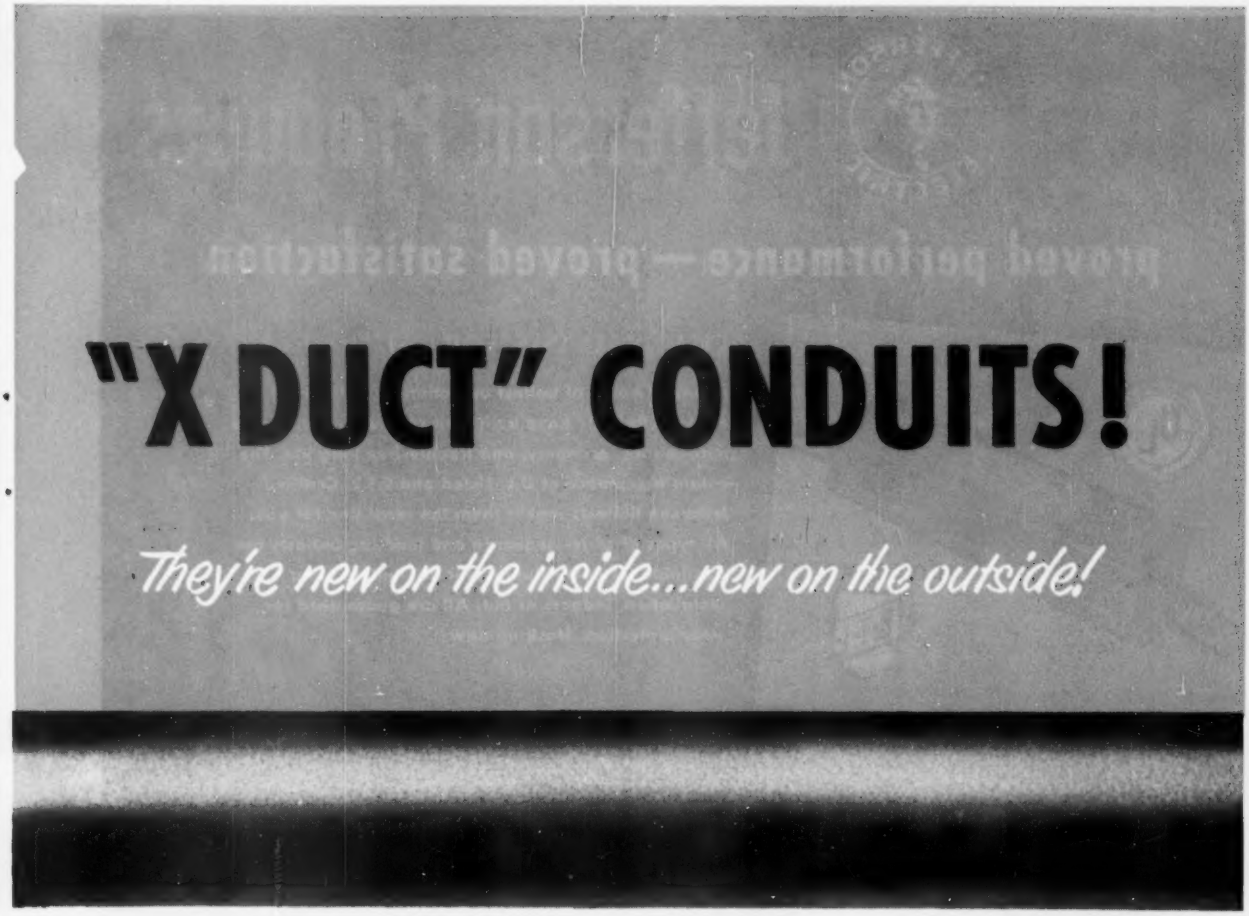

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5. **DESIRABLE COLOR**—"XDuct's" silvery color is highly acceptable for installation in exposed locations.

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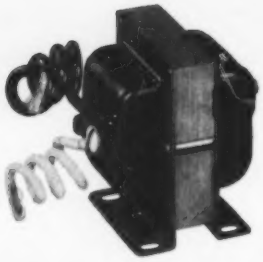

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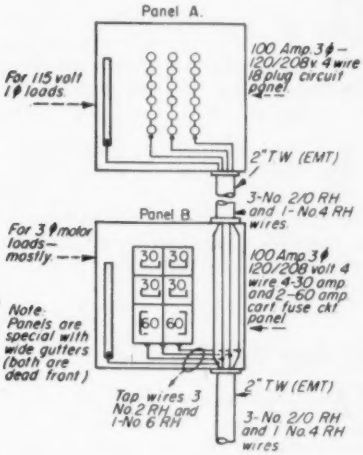
ing method to use would be a common neutral for a four wire multiwire branch circuit as permitted by Section 2111. In this case the neutral under balanced conditions does not carry current, so even though four wires are in the conduit, three only are normally current carrying conductors and for this case Note 4 does not require any reduction. Therefore, four No. 12 conductors would be correct.—B.Z.S.

Panelboard Protection

Q. *Do any Code violations exist in the illustration shown below?*—P.P.G.


Panel A.
100 Amp. 3 ϕ — 120/208 v 4 wire 18 plug circuit panel
For 115 volt 1 ϕ loads
2" T W (EMT)
3-No 2/0 RH and 1-No 4 RH wires
Panel B
For 3 ϕ motor loads — mostly
100 Amp 3 ϕ 120/208 volt 4 wire 4-30 amp and 2-60 amp cart fuse ckt panel
30
60
Note. Panels are special with wide gutters (both are dead front)
Tap wires 3 No 2 RH and 1-No 6 RH
2" T W (EMT)
3-No 2/0 RH and 1 No 4 RH wires

A. In connection with the 18 circuit three phase, 4 wire panel shown, rated at 100 amperes, it appears that this panel should be protected by overcurrent devices which do not exceed 100 amperes. Section 3882 is the rule involved and requires panelboards which are protected by overcurrent devices greater than 200 amperes to be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard. Since the feeder supplying both panels, No.-00 RH in size, has a current carrying capacity of 175 amperes and supplies, in addition to the lighting panel, another panel for three phase motors, it is reasonable to assume that the overcurrent devices protecting this feeder will be larger than 200 amperes due to the starting currents of the motor loads. The same rule also applies to the 100 ampere power panel. Previous to 1946 the rule only applied to panelboards supplying lighting and/or appliance branch circuits. Since then it applies to all panelboards with the one exception for services covered by Section 2371-A-3. In view of this Code requirement, it appears to me that both panels must be protected by 100 ampere overcurrent devices which is the rating of each of the panels involved. In lieu of installing this additional protection the rule might be satisfied by running a separate feeder to each panel. Such procedure is considered desirable by many since it isolates the power load from the lighting load.

There might be a question concerning the No. 2 RH tap at the power panel. Section 2434-C recognizes the 5-ft. tap provided its carrying capacity is not less than the sum of the allowable current carrying capacities for the conductors of the one or more circuits or loads supplied. Assuming that the power panel supplied 2-7½ hp and 4-3 hp, three phase, squirrel cage, induction type motors, we would have two circuits wired with No. 10 conductors and 4 circuits wired with No. 14 conductors. The sum of the carrying capacities of these conductors is 120 amperes, and under such conditions the minimum size tap would be a No. 1 type RH conductor.

In the absence of any detail concerning the loads supplied, it is difficult to comment on the feeder size and I assume there is no question concerning this feature of your illustration. I do not believe there are any other Code requirements which are questionable.—B.A.McD.

Grounding Conductor

Q. *A number of television aerials are being installed in our city and we have in the past required the use of a No. 6 grounding conductor for the grounding of the antenna leadin and the supporting structure for the aerial. We note now that a number of companies supplying these antennas are supplying a No. 12 aluminum wire as the grounding wire. Are we wrong in insisting on No. 6 copper conductors?*—E.H.K.

A. For the grounding of the aerial through a lightning arrester or for the grounding of a mast supporting the aerial, I believe it advisable in all cases to use a grounding conductor which has a carrying capacity greater than the carrying capacity of the antenna leadin. Under Section 8162 of the National Electrical Code you will find the requirement that the protective grounding conductor for receiving stations shall be not smaller than No. 14 copper or No. 12 aluminum and at the present time I believe the cross-sectional area of either of these conductors will have greater carrying capacity than the average leadin. However, it is entirely possible that at some future time it may be found necessary to increase the sizes now required by the Code should leadins have greater carrying capacity. It is, of course, assumed that where a No. 14 copper or No. 12 aluminum conductor is used as the grounding conductor for such an installation it will be protected against mechanical injury. In areas where the buildings supporting these antennas have water distribution systems supplied by underground conductive mains, it is well to ground the grounding conductor to the cold water system rather than to depend upon a driven ground because of the great difference in resistance to earth between the two grounding mediums.—G.R.

Asbestos Varnish Cambric Conductors

Q. *On page 38 of the December issue of Electrical Construction and Maintenance, there is an advertisement of Rockbestos Type AVC wire. In checking with the National Electric Code everything is straight forward except one thing. How do they take type AVC and call it AVA? There must be some reason but I can't see it.*—O.B.T.

A. Section 3102 of the Code, Conductor Insulation, recognizes the following insulations with type letters as follows:

Type V—Varnished Cambric

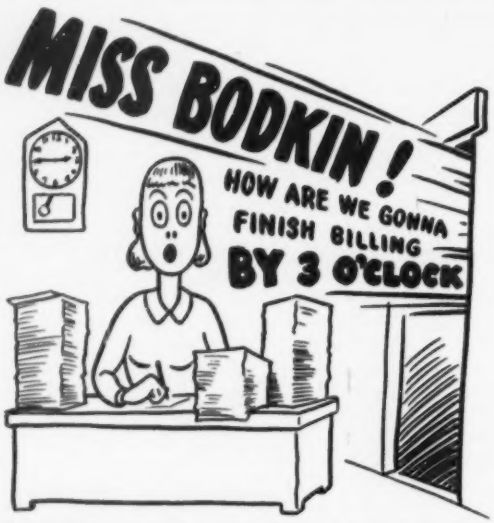
Type AVA—Asbestos and Varnished Cable

Type AVL—Asbestos and Varnished Cable

Type AVB—Asbestos and Varnished Cable

The Table following 93101-e of the Code gives some detail with respect to the construction specification for the various types of insulation. Here again the above types are covered but there is no reference to any Type AVC conductor insulation. As a result, the Code does not recognize any conductor with a Type designation AVC.

The AVC is a Trade designation used by the Rockbestos Products Corporation to identify their particular product which meets the construction specifications for a TYPE AVA conductor as covered by the Code. Reference to the advertisement bears out this point. The table showing the carrying capacity of type AVC cable uses the designation AVA. Underwriters' Laboratories also list the Asbestos-Varnished Cloth conductors as Types AVA, AVB and AVL and all types of this manufacturer's asbestos varnished conductors are listed as



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approved. It is not new for a manufacturer to identify his product in a manner other than covered by the Code or U. L. Terms such as BX, Romex, Ro Marine-Ro Prene, Tirex are only a few of the many designations used by manufacturers to identify their products. On page 31 of the December issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE, National Electrical Products identify their AVA cable by the word "NEasbestos" and no mention is made of the term AVA used by the Code in this advertisement.—B.A.McD.

Section 4115

Q. *As I understand this section it only tells you how to install lights in a closet and would not specifically require that lights be installed in all closets.—C.W.K.*

A. You are correct. This section does not say you must install a light in a clothes closet. It tells you how and what type of light shall be installed if you decide to have a light in any clothes closet.—B.Z.S.

Wiring for Motels

Q. *When wiring a motel, is it necessary to place a branch panel for each individual cabin, or may we use one panel for two apartments or three apartments? These cabins or apartments have a continuous roof with the space between each cabin or apartment used for the storage of the guest's automobile, so we plan to place the branch panel for two cabins in this automobile storage area where it would be protected from the weather and we felt available to either cabin as the garage area is not completely enclosed. As each of these units is provided with a small kitchen, we were told it would be necessary to provide the distribution panel and disconnecting switch within each apartment. Is this required by the Code?*—G.G.

A. Under Section 4241, paragraph 1. you will note the following: "In multi-family (more than two) dwellings, the disconnecting means shall be within the apartments, or on the same floor as the apartment in which the appliance is installed, and may control lamps and other appliances."

We also wish to call your attention to paragraph 1. under Section 2203, which requires the addition of 1500 watts in the calculation of feeder sizes to these individual apartments in addi-

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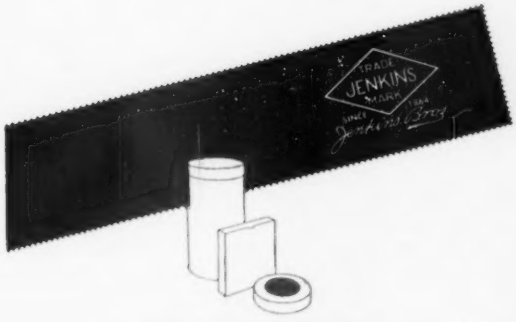

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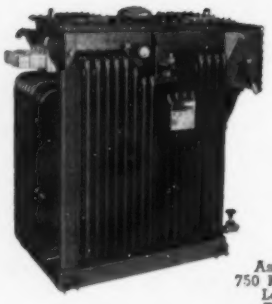

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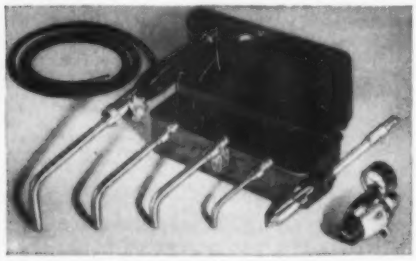

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tion to that required for fixed appliances or lighting to provide capacity for small appliances of a portable nature. This latter, of course, is not necessary where motels are designed strictly for overnight guests and are not provided with facilities for cooking.—G.R.

Bare Neutral—Services

Q. *How does the Code recognize the use of a service entrance cable with a neutral grounded conductor which is uninsulated and is also one size smaller than the insulated conductors of the cable? Could the same principle be applied to service entrance conductors installed in metal raceways such as conduit or tubing?* —T.W.B.

A. In order to clarify my opinion, I am briefly covering the rules involved with your questions.

Section 2303-a of the Code recognizes a grounded neutral service conductor without insulation for use as a service conductor provided the voltage to ground does not exceed 208 volts. This provision is not restricted to service entrance cables. It also applies when conduit or tubing is used as the service raceway.

Section 2304-a-4 requires the neutral conductor to have a current-carrying capacity in conformity with Section 2203-g, but shall not be smaller than the ungrounded conductors when they are No. 8 or smaller.

Section 2203-g permits the neutral conductor to be 70% of the size of the ungrounded conductors when the service supplies household ranges and the range load is computed in accord with the provisions of Column A of Table 29, Chap. 10. The same rule also recognizes a neutral conductor capacity determined on the basis of the maximum unbalance load. As an example a 20 ampere ironer operating at 220 volts, which has no connection to the neutral conductor, is not to be considered in figuring the size of the neutral.

Section 3102 requires conductors to be insulated except where specifically permitted by the Code. One of the exceptions is for services as covered by Section 2303-a.

Section 3106 covers the current-carrying capacity of conductors in line with Tables 1, 2 and 3 of Table No. 10. Note 2 following Tables 1 and 2 advises if bare conductors are used with insulated conductors in a raceway or a cable their allowable current-carrying capacities shall be limited to

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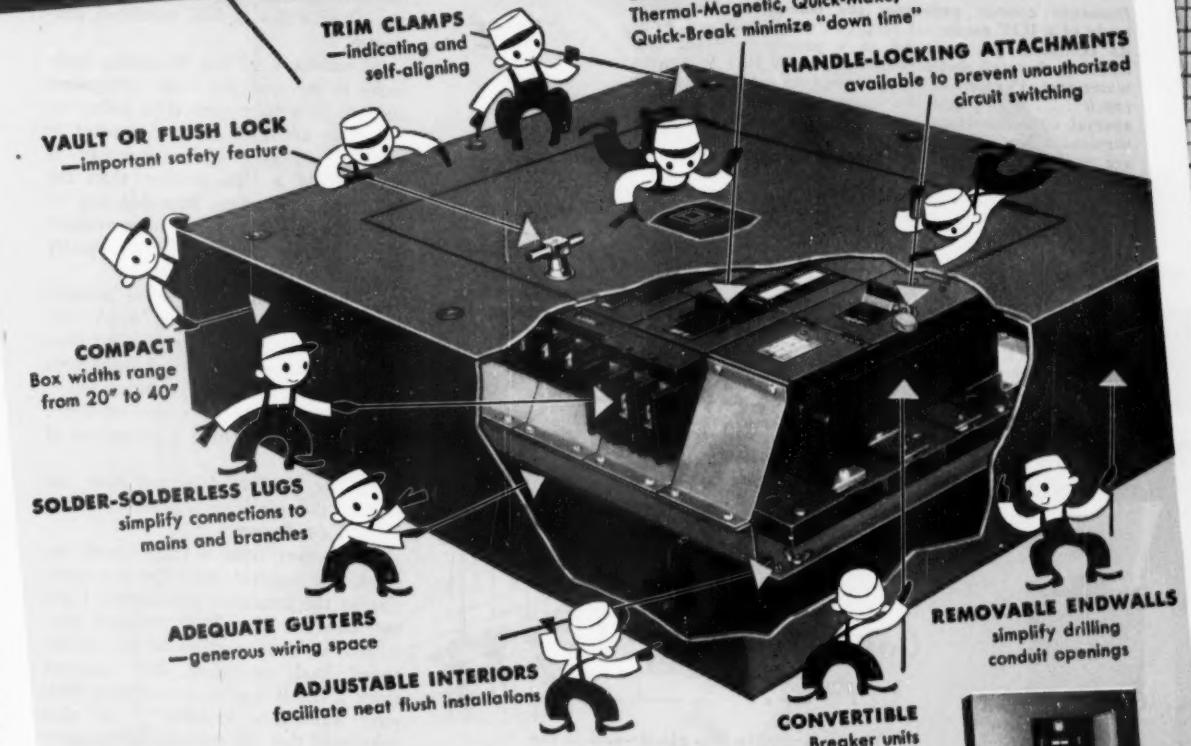

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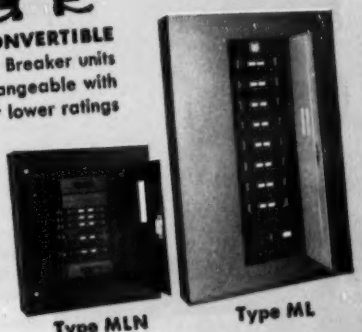

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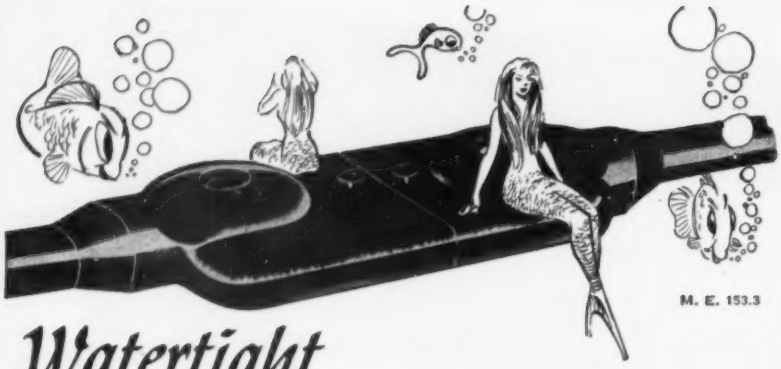

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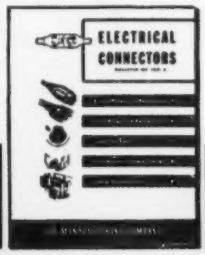

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that permitted for the insulated conductor with which they are used. This limitation is deemed necessary in order to avoid the neutral conductor reaching a temperature that would be injurious to the other conductors. When the bare neutral service conductor is smaller than the ungrounded conductors, this rule would apply as follows:

Assume 2—No. 4, RH insulated conductors and one No. 6 conductor comprises the service. In such a case the capacity of the No. 4 RH conductor would be 85 amps and the capacity of the bare No. 6 conductor would be limited to 65 amps which is the recognized current-carrying capacity of a No. 6 RH insulated conductor.

A summary of the foregoing indicates to me that the Code recognizes the use of a bare neutral in either an SE cable assembly or in a conduit or tubing used as a service raceway. It may be of a size smaller than the insulated conductors provided any of the foregoing exceptions are evident. The principle involved applies equally to cables or raceways.

It is my opinion that the general acceptance of SE cable with the neutral conductor one size smaller than the insulated conductor is influenced by one of the following considerations:

1—Household ranges are involved.

2—Some of the load is connected at 230 volts.

3—The total load served does not exceed the carrying capacity of the neutral conductor.

If, however, none of these conditions exist, the neutral must be the same size as the insulated conductors. I did not consider the 70% demand permitted for that portion of the unbalanced load exceeding 200 amperes since I felt it was not concerned with your immediate problem. I am also convinced that the reasons for the general acceptance of SE cable assemblies as above covered would also apply to conduit services—B.A.McD.

Outlet Boxes vs. Switch Boxes

Q. *I find your questions on the code column very interesting and informative. In the October issue Mr. McDonald's interpretation of Section 3005 relative to continuous cable runs seems to be correct. But it raises the question of whether Sec. 3702, 3703, 7304 apply to switch and junction boxes. I had always supposed that it applied to the three types of box uses.*

Sec. 3363 seems to indicate that it is permissible to fish romex from a base

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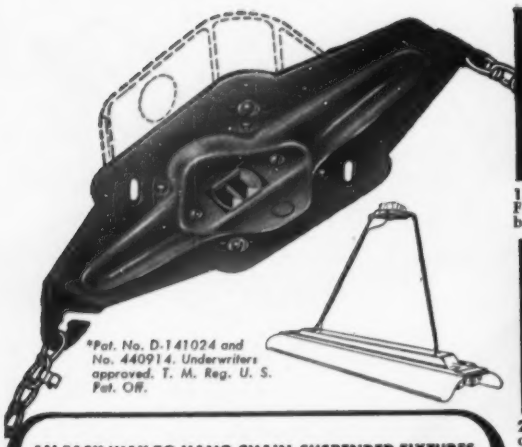

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2. Screw hanger to outlet box—only two screws needed. No centering, punching, or drilling. Screwdriver only tool needed.

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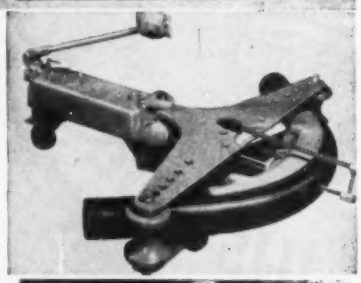

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outlet to ceiling light; but if a wall-switch is installed the plaster will have to be removed to secure the romex at not more than 4½ in. intervals. In another situation the romex may be fished from base outlet to ceiling light but the switch loop to a wall switch must be fastened. Apparently none of these restrictions apply to BX. Will you please comment?—H.F.H.

A. Previous to now, the point which you have raised has escaped my attention and I sincerely agree that the present wording of Section 3702, 3703 and 3704 raises the same question as presented by Section 3005. For the benefit of our readers, I will endeavor to point out the question, concerning the above Code Sections, which you call to my attention.

Section 3702 prohibits the use of round *outlet* boxes when conduits or connections requiring the use of locknuts or bushings are to be connected to the side of the box.

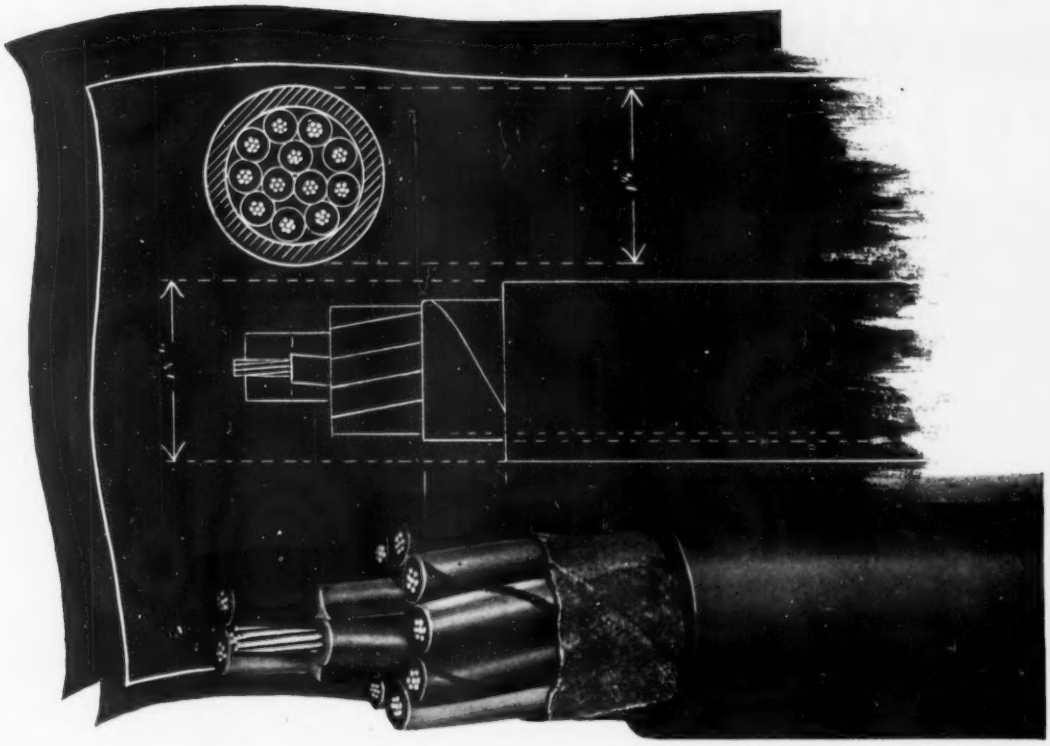
Section 3703 prohibits the use of a metallic *outlet* box with knob and tube work or non-metallic sheathed cable etc.

Section 3704 requires metallic *outlet* boxes when used with K and T work or non-metallic sheathed cables and mounted on metal or metal lath ceilings or walls to be insulated or grounded.

All of these rules refer to outlet boxes and in line with the definition of an outlet, none of these rules would apply to a switch or a junction box. This, in my opinion, never was intended and as far as I know, all of us have assumed that these rules equally applied to switch and junction boxes as well as outlet boxes. The fact remains however, irrespective of how we feel about it, that the present wording of these rules exclude switch and junction boxes. If the word outlet was eliminated from these sections, the question you have raised would be clarified and answered. This question is identical with that presented by Section 3005.

Your observation regarding Section 3363 also involves the use of the term "outlet" and your conclusion, in my opinion, is correct. Section 3343 covering armored cable also is involved to a lesser degree. While this rule does not use the phrase "the cable may be fished from outlet to outlet," as used in Section 3363, it does limit the support of the cable within 12 inches from an outlet box. As a result, there is no requirement for supporting cables entering switch or junction boxes.

The questions which you have raised shoud be submitted for consideration to the NFPA, and I am taking such action.—B.A.McD.



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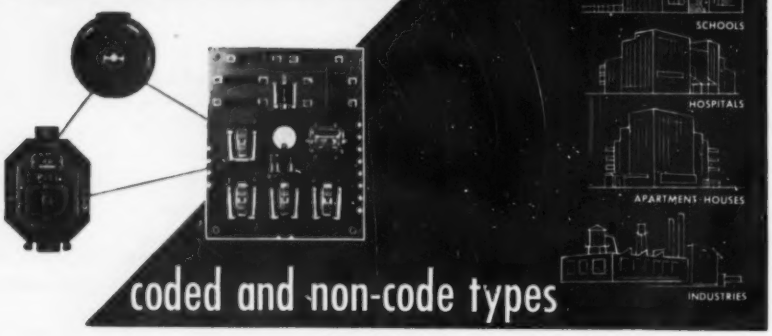
Interior Fire Alarm Systems



coded and non-code types

Complete reliability is the one thing we demand from a fire alarm system. Therefore, when ordering Interior Fire Alarm Systems, be sure to specify equipment (control panels, stations, and fire alarm bells) produced by Signal Engineering & Manufacturing Co., the originators of A-C Fire Alarm Systems.

Both coded and non-code types are available in various arrangements depending on type of building or establishment. Although Interior Fire Alarm Systems are intended primarily for warning occupants of a building, they can be connected into a municipal system.

Engineering representatives in principal cities are available to assist in specifications.

Write for Bulletin FA-3

Wheelock FIRE ALARM SIGNAL ENGINEERING & MFG. CO. 154 WEST 14TH ST. NEW YORK 11, N.Y.

Ground Wire and Lightning Rod

Q. *How far should a ground wire be placed from a lightning rod?—C.P.T.*

A. Section 2534 requires 6 feet spacing between the metallic ground wire enclosure (conduit, EMT or armor) and the lightning rod conductors. If this spacing cannot be maintained then a bond connection must be made.

2546 has a similar rule for spacing between the metal frames and cases of electrical equipment.

2586 prohibits the use of the lightning rod conductor or the lightning rod grounding electrode for grounding the wiring system and equipment. It does permit the bonding together of these electrodes.—B.Z.S.

Different Systems, Same Raceways

Q. *Is it permissible to install in square duct, 115 volt, 400 cycle, three phase ungrounded wires; 12 and 24 volts dc wires; 115 volt, single phase, 60 cycle wires; 230 volt, single phase, 60 cycle wires; 220 volt, 3 phase, 60 cycle wires; when all wires are approved for 600 volts? Could it be possible to also install coaxial cable in same square duct? Voltage rating of coaxial cable is not given.*—P.P.G.

A. According to Section 3011 of the Code, conductors of light and power systems of 600 volts or less may occupy the same enclosure without regard to whether the individual circuits are ac or dc provided all conductors are insulated for the maximum voltage of any conductor within the enclosure. The same rule also prohibits the installation of conductors of signal or radio systems in the same enclosure with conductors of light and power systems. If this second provision is satisfied, it appears to me that the 12 and 24 volt dc conductors; the 115 volt, single phase, 60 cycle conductors; the 220 volt, single phase, 60 cycle conductors; and the 220 volt, 3 phase 60 cycle conductors could be placed in the same raceway provided all conductors are insulated for at least 220 volts.

Since one of the principal applications of coaxial cable concerns television installations which are covered by Article 810, Radio Equipment, it follows that such a cable could not be used in the same raceway with power and light conductors. Coaxial cable feeders are also used to supply high

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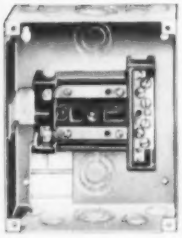
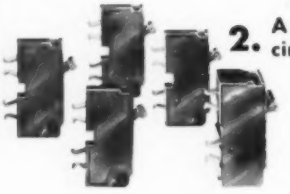
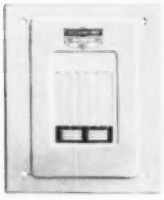


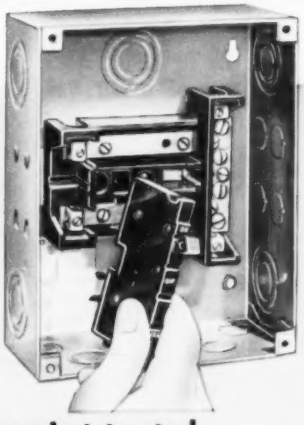
1. A case with bus bar



2. A few circuit breakers



3. A cover (surface or flush)



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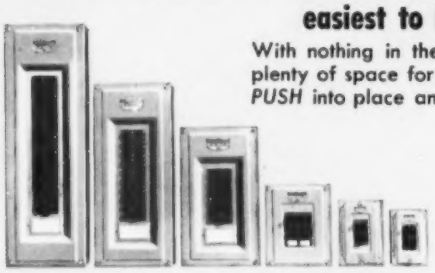

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UNIT BREAKER
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frequency, inductive heating units which require an electrical system entirely separate from the normal power and light system. Such systems are covered by Article 665 and could not be associated with normal power and light conductors.

The high frequency, 115 volt, 400 cycle, 3 phase conductors which might concern high frequency tools (360 cycles) are also separate systems served by motor generators which are fed by the normal power system. While the Code is not specific on this point, it is my opinion that conductors connected to such frequencies should not be associated with 60 cycle power and light conductors. Section 3012 contains a general statement which requires the number of conductors in a raceway to be limited so that the heat generated will be dissipated without injury to the conductors. Since an increase from 60 to 400 cycles does influence the carrying capacity of a conductor, it is quite possible that this general requirement would be violated. —B.A.McD.

S. E. Cable— Interior Wiring

Q. *Will you please interpret that portion of Section 3382 permitting the use of service entrance cable without individual insulation on the grounded conductor to be used as feeders from a service cabinet to supply other buildings.*

May above S. E. cable without insulated neutral originate in a service cabinet in the building and run the entire length of the building within the building and then feed another building, or should that portion of the feeder running within the building be conduit, armored cable or other approved wiring normally used within a building?—L.H.J.

A. Section 3382 of the Code permits service entrance cable, without individual insulation on the grounded conductor, to be used as a feeder from the service cabinet to supply other buildings. The S. E. cable may be run within the building for its entire length if necessary. Section 3381 also advises that S. E. cable, used for interior wiring, such as in the present case, shall comply with the provisions of Sections 3001 to 3020. One of these provisions, Section 3003-b, requires conductors to be adequately protected from mechanical injury. It therefore follows that if the run of cable is in an occupancy and is so located that it would be exposed to mechanical injury, additional protection would be required. According to

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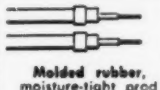

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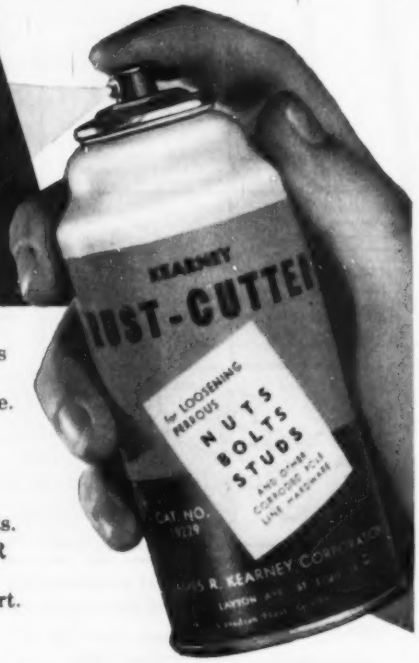

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Underwriters' Laboratories Type SE cable does not have inherent protection from mechanical abuse but the Type ASE cable does have such inherent protection. As a result, the answer to the last part of your question is as follows: If the cable is free from exposure to mechanical injury, no additional protection such as conduit or armor would be required. If the cable is exposed to mechanical injury, it must be protected from same by the use of the armored Type ASE cable or be protected by any of the methods covered by Section 3364 which apply to unarmored cables.—B.A.McD.

Conductors

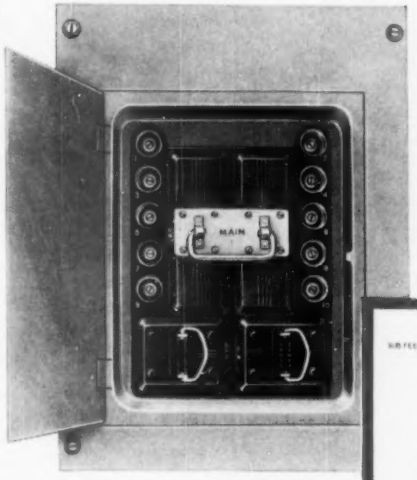
Q. *In a building served by a three wire 110-220 volt service, is there any provision contained in the Code which would prohibit all circuits supplying single phase 110 volt motors from being connected to the same leg? I recently had such an installation completed and rejected by the local inspector, who claims that I am bringing about an overload on the neutral by not balancing the circuits supplying 110 volt motors between the two ungrounded legs.*—A.M.B.

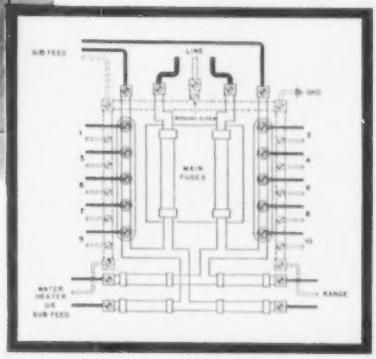
A. Section 2203, paragraph g, starts out as follows: "The neutral feeder load shall be the maximum unbalance of the load determined by Section 2203." Therefore, if you place all inductive load, such as your motor load, on one leg and all resistance load, such as your lighting and heating load, on the other leg and use only the running current amperage of the motors for the determination of the size of the neutral conductor, it is possible for one to seriously overload this conductor and eventually destroy the insulation on it. Because of this, it was proper for your inspector to insist on the 110 motor load being split between the two ungrounded legs of this three wire service. While the magnetizing current required by an induction type device does not register on a meter, it does register in the form of heat on a conductor and with the ever increasing number of small motors being used in dwelling occupancies, it becomes necessary that the contractor utilize extreme care in dividing this load between both ungrounded conductors.—G.R.

Oil Transformers In Buildings

Q. *Can a 10 kva, 1 phase, 440/220 volt, oil filled transformer be*

ENGINEERED TO SAVE YOU TIME AND MONEY





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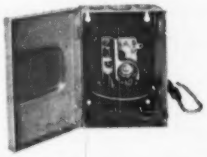

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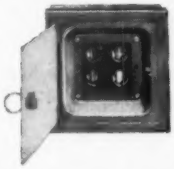

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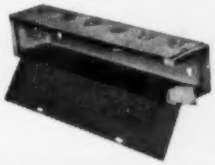

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installed indoors in an area classified as combustible? Can 3-10 kva, 1 phase, 440/220 volt, oil filled transformers be installed in parallel, 1 phase or delta 3 phase, in an area classified as combustible?—P.P.G.

A. Section 4523 of the Code permits an oil filled transformer, not exceeding a rating of 10 kva and 600 volts, to be installed inside in a section of a building classified as combustible, without resort to the use of a vault. The first sentence of this rule however indicates that it may be necessary in some cases to isolate the transformer from other combustible materials. In some cases it might be necessary to mount the transformer on a concrete base or use non-combustible barriers or enclosures to prevent an oil fire from igniting such materials.

Three 10 kva transformers, 440/220 volts, operating in multiple or as a 3 phase bank would have a total capacity of 30 kva. According to Section 4523 of the Code, they could be installed in a building that is classified as fire-resistant construction provided they were isolated, as above covered, from combustible materials. Such a combination could not be installed in a building rated as combustible. They would have to be installed in a vault and since the total capacity is less than 100 kva the vault could be constructed of 4 inch reinforced concrete. Code reference 4523-a. If the transformer or transformers are mounted outside of a vault see Section 4515.—B.A. McD.

Official N.E.C. Interpretations

INTERPRETATION NO. 390

(Issued May 15, 1953)

SECTION 3105—Conductors in Multiple

Question: Section 3105 of the National Electrical Code permits the paralleling of conductors. If five 3/0 conductors are paralleled on a three phase, 3 wire circuit,

1. Are these figured as fifteen or three conductors in so far as the Code is concerned?

Answer: They are figured as fifteen conductors.

2. What percentage of reduction in current carrying capacity must be applied to the paralleled conductors in accordance with Note 4 of Tables 1 and 2 of the 1951 edition of the Code?

Answer: At least two runs of conduit must be used for the fifteen conductors. If 9 conductors were run in one conduit and 6 in the other, the current carrying capacity for the 9-conductor group would be 70 percent of normal rating and for the 6-conductor group 80 percent of normal rating.

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"What Is It?"

"What kind of [illegible]nkety-blank wire is this, anyway?

"We took this [illegible]il off a job some time ago, stuck [illegible]in the store room, and now we wa[illegible] to use it again.

"But is it hea[illegible] enough to carry the load?"

"Send it down to Engineering to have somebody figure the wire gauge, somebody says.

"Great. Gotta be miked. Gotta look up the current-carrying capacity in a handbook. Gotta get it delivered back to me. Very practical suggestion . . .

"And then, what kind of jacket has it got?

"I suppose now somebody is going to tell me to send it out to a chemical laboratory to get it analyzed.

"Not me. I'm going to sit right down and write . . .

INTERPRETATION NO. 391

(Issued May 12, 1953)

SECTION 2003—Use of Autotransformer on Emergency Systems.

Statement: An emergency power source, consisting of a two-wire, 240-volt generator, supplies emergency power in the event of failure of the 120/240-volt main power supply. The neutral conductor in the main power supply is properly grounded at the supply transformer and at the service. When the main power supply is disconnected and the emergency supply takes over, the neutral is fed through solid to the mid-point of an autotransformer, the outer terminals of which are supplied by the two-wire, 240-volt generator.

Question No. 1: Does Section 2003 of the Code permit this use of an autotransformer to derive a 120/240 volt, three-wire circuit from the two-wire, 240 volt generator?

Answer: No.

Question No. 2: Is the grounded neutral wire from the outside commercial supply transformer to the normal service switch and on to the emergency supply service switch and autotransformer mid-point permitted to be bare?

Answer: Yes.

Question No. 3: Where the three-wire supply from the transformer on the load side of the emergency circuit service switch is run to a separate building, under the same management and to a control switch in that building, may the grounded neutral conductor in underground single conductor cables connecting the emergency service switches in the two buildings be bare?

Answer: Yes.

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THE TYPE—SO, W, G, or WELDING CABLE . . . .

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THE SIZE—18, 16, 14, 12, 10, 8, 6, 4, 2, 1, 1/0, 2/0, 3/0, or 4/0

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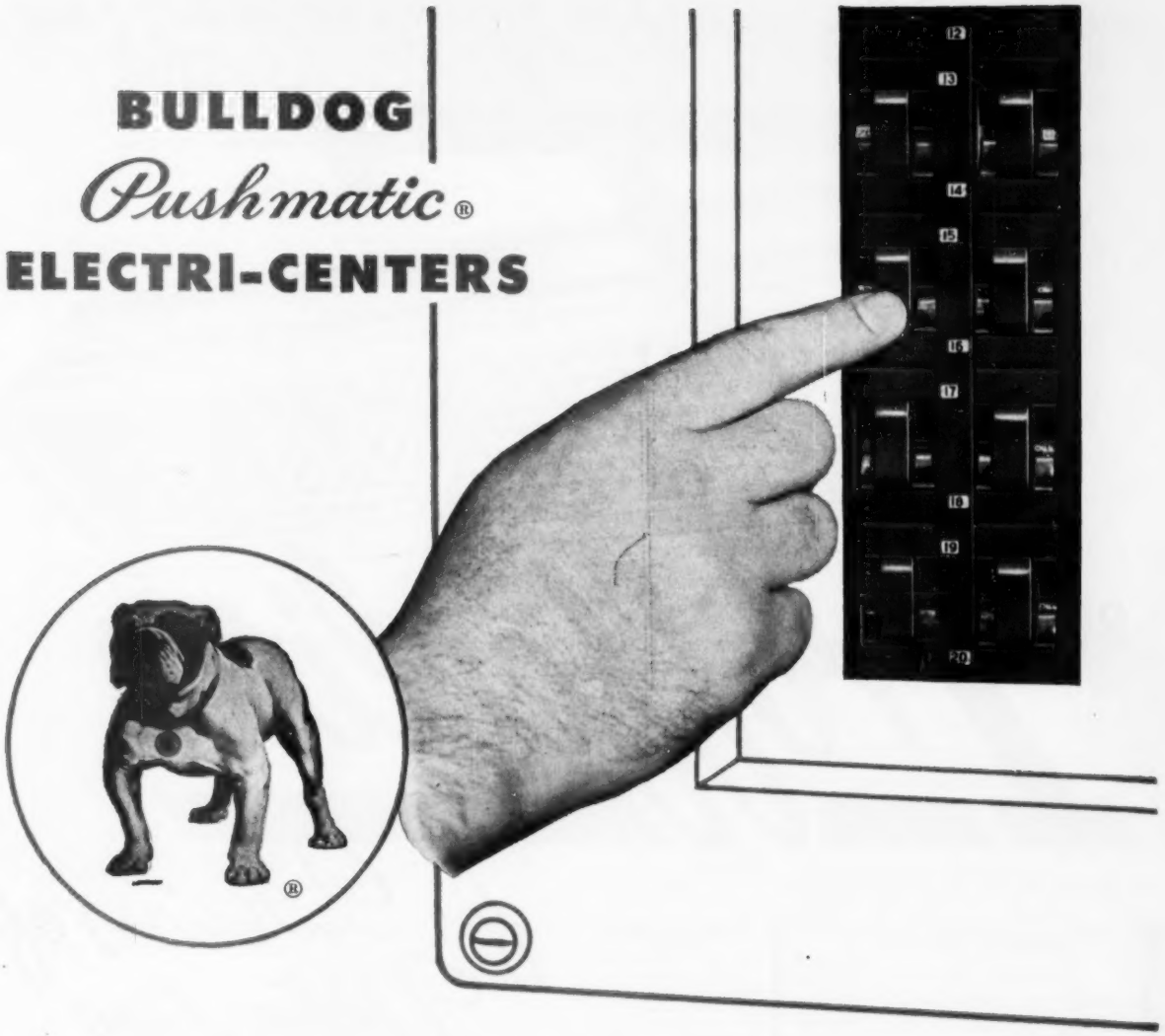

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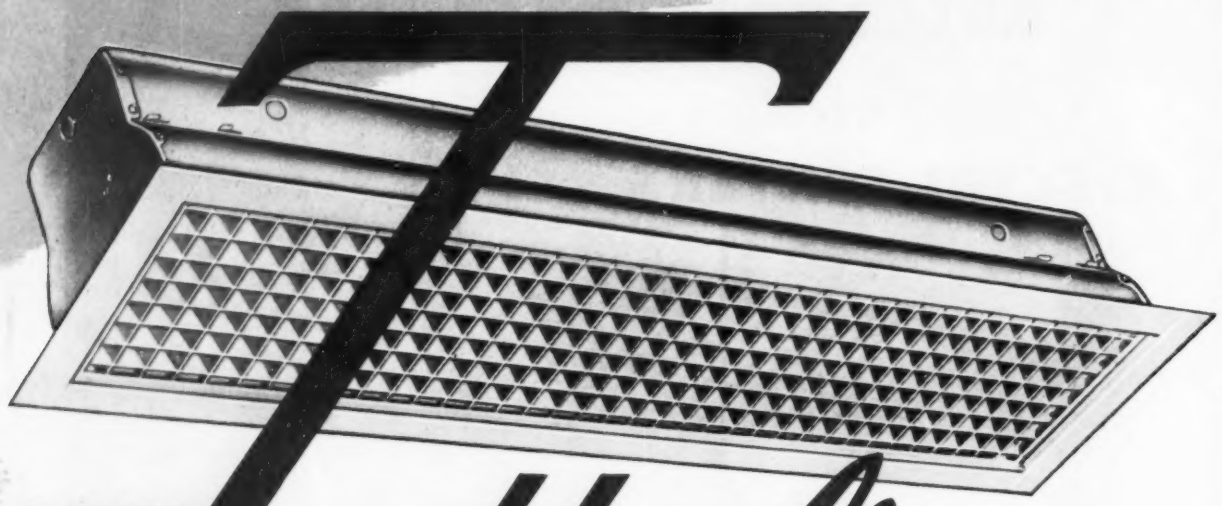

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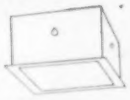
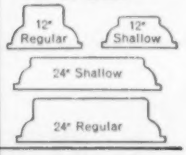
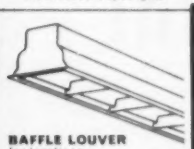
DIRECLITE
adjustable, incandescent spotlight.



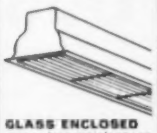
CORNER FILL-IN
joins sides of rectangular arrangements.

COMPLETE RANGE OF SIZES



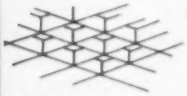


BAFFLE LOUVER
for locations requiring extra-high light levels.



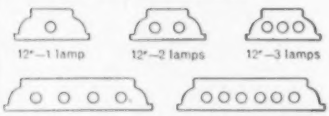
GLASS ENCLOSED
means less maintenance, better lamp operation.

6 MOUNTING STYLES
—general purpose, T-bar, Simplex ceiling, plastic frame, wood furring and channel furring (illustrated).



MOLDED PLASTIC LOUVERS
No warpage . . . no discoloration.

5 LAMPING ARRANGEMENTS



Versatility *plus* efficiency and distinctive appearance . . . that's *Trofferlite*. Offices, stores and commercial establishments of all kinds take on a new look of distinction with these trim, slender units which appear to be a part of the ceiling. There is no limit to the variety of designs, arrangements and architectural effects you can achieve with these recessed Troffers. They are available in a wide range of styles and sizes, in individual units or continuous rows, as shown at left.

For Interiors of Distinction, specify Versatility "*Plus*" . . . specify recessed *Trofferlites*. Complete catalog data sheets sent on request.

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Leader Line

Sold Exclusively through Electrical Distributors

Exclusive licensee of the Leader Line in Canada: Robertson Irwin Limited, Hamilton, Ontario

Benjamin Electric Mfg. Co., Leader Division, Dept. H, Des Plaines, Illinois, also makers of famous Benjamin lighting equipment and sound signals for Industry, Institutions and Commerce.

B-673

Modern Lighting

NEMA Accepts
***Challenge of the Fifties*, Sponsors . . .**

NATIONAL INDUSTRY-WIDE RELIGHTING PROGRAM

- **Approves Lighting Certification Plan**
- **Invites All-industry Participation**
- **Votes Funds to Cover Program Operation**
- **Sets Up National Lighting Bureau, to—**
  - **Encourage formation of local lighting bureaus**
  - **Work with and give guidance to local bureaus**
  - **Develop manual for certification plan**
  - **Provide sales and technical training manuals**

By Berlon C. Cooper

THE Lighting Industry at long last, 74 years after Edison's invention of the electric light, has its first National Lighting Bureau, and its first certified relighting program for its major lighting market.

The National Electrical Manufacturers Association has announced approval of plans for a nationwide certified relighting program. It is sponsored by the members of NEMA's Industrial and Commercial Lighting Equipment Section, and will embrace relighting for commercial and industrial interiors. It is designed for all-industry participation, and is essentially a long-term lighting market development program. Under consideration for several years and under diligent study and research for more than a year, this broad program has been developed and outlined by a special NEMA Section Executive Planning Committee for Market Development, chairmaned by Sam B. Williams, Sylvania Electric Products Inc., and former president of the Illuminating Engineering Society. NEMA Section members have voted funds to cover its operation until Jan. 1, 1955.

National Lighting Bureau

A National Lighting Bureau will be set up at NEMA headquarters in New York City to put this program into operation. It will carry on its work under the direction of an Executive Committee appointed by the Section, and the Bureau's staff will be under the supervision of the Managing Director of NEMA. The principal function of the National Lighting Bureau will be to encourage the formation and licensing of local Lighting Bureaus to operate under the national certified relighting program, and to provide guidance to these local Bureaus. Funds provided by the NEMA Section will be used for the operation of the National Lighting Bureau, which will not be responsible for operating expenses of the local Lighting Bureaus. The Executive Committee will invite the assistance of advisors from the several national electrical associations and others, in order to maintain an all-industry interest and viewpoint.

In the initial stages the National Lighting Bureau will set up a small number of pilot activities to test out every phase of the program. It is expected that the first pilot operation will begin early this fall, and that all will be in operation by next spring. NEMA reports that requests have already been received from interested local industry groups for consideration as pilot locations. Upon completion of these pilot activities, the program will be promoted on the widest scale possible, using the results of these initial activities for future guidance.

The main objective of this market development program is the relighting of commercial and industrial interiors to accepted industry standards. To accomplish this objective, the program will be implemented by: 1) a means of assuring the customer that his lighting installation meets certain standards; 2) promotion; and 3) sales and technical training.

Local Lighting Bureaus

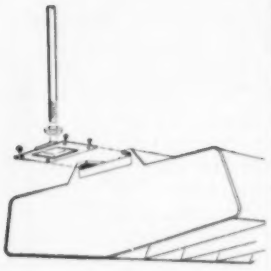
The broad aspects of the program will be carried out by the National Lighting Bureau. Local Lighting Bureaus will set up certifying authorities at the local level to check plans and to stamp them for certification when they are in accordance with accepted minimum standards. The local Lighting Bureaus will also set up and operate elementary and advanced lighting schools to provide sales and technical training to employees of the trade. Training courses will be written in book form and sold to local Bureaus by the National Lighting Bureau for class instruction. The National Lighting Bureau is authorized, as part of its work, to develop a suitable sales training manual based upon field investigation of the problems attending the sale of relighting. In a survey of electric utilities and wholesalers conducted by the Executive Planning Committee during its study of this program, an almost unanimous desire for a sales training program designed to fit the problems of the relighting market was disclosed.

Written courses in lighting techniques are also to be prepared. The first course, it is announced, will cover the elementary phase of lighting, and an advanced course will take up design through a series of actual case studies.

Spokesmen for the NEMA Section stress that this program is designed for all-industry participation at the

Wakefield introduces the CAVALIER

a beautiful new luminaire with full length luminous plastic side panels — and sliding stem plates to simplify mounting.



No opaque metal frames mar the beauty of the Cavalier's luminous plastic side panels. Yet the construction is sound and sturdy, for inside is a supporting steel frame which also acts as an internal reflector.

But there's more than beauty to recommend this entirely new luminaire. There's a wonderfully ingenious sliding stem plate which can be moved from end to end to support the Cavalier at any point, completely eliminating problems of in-line spacing of mounting points. Together with adjustable ceiling straps and hook-on stems, this new feature greatly simplifies the installer's job.

NOW CONSIDER A FEW OTHER GOOD POINTS:

1 A special low brightness finish on louvers, side reflectors and channels keeps brightness contrasts down.

2 Equipped for Rapid Start or Slimline lamps. Two models, the Cavalier II (two lamps) and the Cavalier IV (four lamps).

3 Louvers are released by press buttons and suspend on chains.

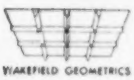
4 Snap-on end plates with each body —no extra set of end plates to be ordered.

5 Can be ceiling-mounted without extra fittings.

6 8-foot channels for minimum suspension points.

For the complete story of this beautiful new streamlined direct-indirect luminaire, write for an 8-page 3-color folder. The F. W. Wakefield Brass Company, Vermilion, Ohio.

Wakefield Over-ALL Lighting


WAKEFIELD GEOMETRICS

THE CAVALIER

THE GRENADIER

THE PACEMAKER

THE COMMODORE

THE STAR

THE WAKEFIELD CEILING

local level, through locally-sponsored Lighting Bureaus. Each local Bureau will set up its own certifying authority to examine plans prior to installation. Plans that meet the minimum standards and practices as published by the Illuminating Engineering Society will be stamped for certification. Then when the installation follows the plans, the installing contractor may so certify and warranty the job. Certificates will be countersigned by the certifying authority. Installations only, and not lighting equipment, will be certified.

Simple Certification Formula

A simple method for quick inspection of plans by a non-technical person has been worked out so that certification will be based on lighting standards which have wide industry acceptance. These standards are minimum footcandle standards for quantity; and spacing, mounting height and shielding standards for quality. This simplified method, which ultimately boils down to "watts per square foot" tables for different types of light sources, and for lighting units with different values of shielding and light distribution, is based on an extensive and laborious study of room indexes, maintenance factors and coefficients of utilizations for a wide range of types and sizes of lighting units as published in the Second Edition of the IES Lighting Handbook. Through these studies a special simple formula was devised, which can be applied easily by a non-technical person, to any lighting plan. While this method may not provide the full accuracy of results as would be provided by actual measurement of footcandles and brightnesses with accurate instruments, nor as would be provided by calculation using the lumen method, when all the factors are known accurately, it does provide a practical measure of results within a reasonable range of accuracy.

Announcement of the NEMA national certified relighting program is most timely. The lighting industry has long needed an industry-wide lighting program as was pointed out editorially in this publication last October (*EC&M*, October, 1952, pp. 88-91). While the NEMA program is limited to commercial and industrial lighting—stores, offices, schools and factories—it is nevertheless a broad program covering the major lighting market. It may quite logically lead to a broadened, all-inclusive, industry-wide lighting program, with an expanded program of promotion and educational training.

The time has now arrived when producers and distributors of lighting equipment must compete effectively with many other industries for the consumers' dollars. New lighting markets are needed to absorb present lighting production capacity, which is in excess of the industry's sales rate, and to permit a continued orderly growth of the lighting industry. As has been pointed out often in this publication over past months, new building construction alone will not support the lighting industry from today on.

The NEMA relighting program, as its name implies, is directed at the huge existing relighting market. Previous market research by the NEMA Section in Indianapolis disclosed that the lighting in more than 85% of commercial and industrial interiors was substandard, that is, below the IES minimum recommended values. These are the small jobs, requiring up to 10 and 25 fixtures in the main, which carry their full profit and are usually sold "out of competition". The size of this market is so great, and dependent on so many factors, that it cannot be estimated or predicted with any reasonable degree of accuracy. It was conservatively tagged at five billion dollars in our "Lighting Market Outlook" last October (*EC&M*, Oct. 1952, pp. 82-85), equal to about 25 cents per square foot for the estimated 20 billion square feet of floor space in commercial and industrial establishments which need better lighting. With effective promotion, however, this potential could very easily be raised to ten billion—even 15 to 25 billion—dollars. Size of the relighting market therefore depends on what is done to promote and sell it.

Growing Relighting Market

The NEMA program objective—certification of relighting installations which at least meet IES minimum standards—is basically sound, and is certainly the minimum quantity and quality which any relighting customer should consider. It is estimated that about 5% to 7% of the relighting market is now tapped by the lighting industry each year, and that this for the most part is done in a substandard fashion. But properly promoted through industry-wide cooperation, this relighting volume should at least be doubled, quite logically it could be trebled. Even at this increased rate of sale, it would require some ten or more years to completely sell this market, during which time lighting standards in all probability will have doubled, thus establishing a new lighting market goal.

This new national relighting program should interest all other branches of the industry and should gain their enthusiastic cooperation. It offers the electric utilities a particularly high revenue load per kilowatt, and an opportunity to absorb their expanded capacities. It provides a market for small and medium sized orders for wholesalers, carrying a maximum profit. It gives electrical contractors an opportunity to promote and develop a much needed new market, especially timely if new construction work tapers off next year as many predict will happen. And it provides electrical leagues and others a program to balance their efforts which have been one-sided in appliance promotion.

The NEMA relighting program is timely. It is sound. It provides industry-wide benefits. NEMA has done the spade work, provided the outline, is organized and financed to provide aid and guidance to all local interested groups. The success of this program will rise or fall with the interest and cooperation afforded at the local level.

LETTERS OF SIGN and face of restaurant are illuminated by series of floodlamps built into a narrow soffit at the second floor level.

Floodlamps Highlight Restaurant Facade

Attention of New York City pedestrians is attracted to the brightly illuminated facade of Schrafft's restaurant on East 42nd Street which is highlighted by 18 floodlamps incorporated into a second-floor level soffit. Since lamp centers are slightly further away from the face of the building than the gold-colored metal letters of the Schrafft sign, it is noticed as an interesting study in subdued surface brightness plus 3-dimensional relief.

Model Machine Shop Uses 4-Lamp Units

In the model machine shop of the Greist Manufacturing Co., New Haven, Conn., illumination in the order of 35-footcandles is obtained on work-

KLEIN

equipment you can rely on

Talk to any old-timer on the job and he'll tell you Klein equipment is his choice for comfort—for safety—for service. Look for the familiar Klein trade-mark on pliers, safety straps and belts, climbers, grips and wrenches. Klein has been serving the electrical industry "Since 1857."

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Write for your free copy of the Klein Pocket Tool Guide today!

"Since 1857"

Mathias KLEIN & Sons
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3200 BELMONT AVE., CHICAGO 18, ILL.

GENERAL ILLUMINATION is provided by 4-lamp 8-foot surface-mounted units containing 96T12 slimline tubes. Reflectance factors of the white acoustical ceiling, light green walls and natural maple flooring are high.

ing areas at the machines. The lighting installation consists of Ruby-Phylite 4-lamp fixtures, surface-mounted on the white acoustical ceiling, and lamped with 4 standard white 96T12 slimlines. Lengthwise, fixtures are mounted 12-feet on centers, and rows are 9 feet apart. Light green walls provide good reflectivity, while the light maple flooring likewise contributes to a comfortable brightness ratio. Side light from the fixtures illuminates the ceiling tiles, while the diffusing panels on fixture bottoms minimizes glare and improves shadow-reducing diffusion.

Power for the various machine tools is distributed through plug-in bus suspended just below the structural beam line, while branch connections are effected through conduit drops and short flexible armored cable sections. Duplex receptacles mounted between windows provide low voltage current for hand power tools used at the various work benches.

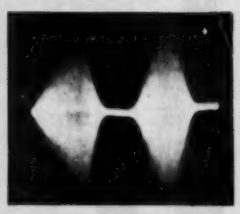
50-Year-Old Library Judiciously Relighted

STACK LIGHTING is still in the experimental stage, with several types installed at present and under consideration. This installation consists of standard cool white lamps operating at 200-ma in DayBrite fixtures. Illumination on the vertical book bindings ranges from 50-fc at the top to 40-fc in the middle and 15-fc at the bottom.

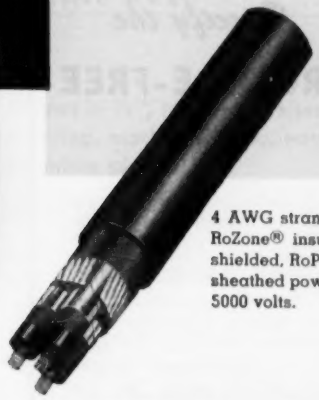
The Free Public Library of Newark New Jersey, constructed around the turn of the Century, is an impressive stone structure with broad stairways, large rooms, high ceilings and massive architectural features. All of these features are as impressive today as they were when the building was erected. Yet many of these details were being overlooked, for planned illumination had not kept pace with modern lighting progress, and displays of art and architecture remained unappreciated in shadows.

The present popular Reading Room, shown in the accompanying illustration, is a case in point. This 90-by-35-foot room with a 22-foot ceiling possesses an interesting series of famous printers' marks, painted on the groin vaults surmounting the column capitals, yet they were scarcely visible before the room was modernized.

Modernization included an acoustical ceiling, dropped slightly from the original ceiling to permit the installation of a narrow cove. Above each



Oscilloscope trace indicates ionization of this power cable.



4 AWG stranded 3/c RoZone® insulated, shielded, RoPrene sheathed power cable, 5000 volts.

How we prevent trouble *before* trouble begins

The instrument, pictured above, is your assurance of maximum protection against one of the most insidious of cable hazards . . . ionization.

Ionization, which is the electrical break-down of air in pockets within the insulation, or between insulation and conductor or shield, often causes several destructive electrical effects. Included are possible ozone cutting, reduced dielectric strength and increased dielectric loss . . . any or all of which may result in reduced cable efficiency and early failure.

Perhaps the most hazardous thing about ionization is that ordinary visual, physical and electrical tests will not show evidence of it.

But you can count on maximum protection against ionization when you specify Rome insulated cables. *Every foot of every cable rated at 3000 volts or over is thoroughly tested by this specially designed ionization detector.*

This completely new NONDESTRUCTIVE testing method accurately measures the corona level of the entire cable. This extra step in Rome Cable's standard manufacturing procedure was developed by Rome engineers and was first described in AIEE paper 48-198, "The Measurement and Investigation of Ionization Level of Rubber Insulated Cables," presented in August, 1948. A copy is yours for the asking —check and fill in slip below.

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TORRANCE • CALIFORNIA

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Please send me a copy of ..... AIEE paper 48-198
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Company.....
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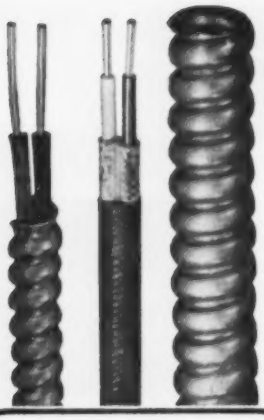

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For installations that will give years of satisfactory service, specify:

CLIFTON ARMORED CABLE

The flexible galvanized steel armor affords maximum mechanical protection for the moisture-proof, flame-retarding insulation which covers the conductors.

"CLIFTX" NON-METALLIC SHEATHED CABLE

Conductors are protected by five layers of insulating materials, with a rugged outer covering of moisture-resisting and flame-retarding overall braid.

CLIFTON FLEXIBLE STEEL CONDUIT

No waste—short pieces can be clamped together with couplings.

OTHER CLIFTON PRODUCTS include CLIFTON E.M.T., Rigid Conduit, and Pierceway Plastic Duct Wiring Systems.

WE MAKE NO BONES ABOUT IT . . .

CLIFTON PRODUCTS ARE THE BEST IN THEIR FIELD

CLIFTON

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75 Montgomery St.
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Factory: Baltimore, Md.

FAMOUS PRINTERS' MARKS painted above the columns are softly illuminated by warm white 72T8 lamps mounted above edges of suspended acoustical ceiling. Surface-mounted louvered 4-lamp Fullerton fixtures on the ceiling proper provide 50-footcandles to reading tables; between 42 and 25-fc to book shelves.

printers' marks, in this cove, a 6-foot T-8 warm white fluorescent has been installed, softly illuminating the interesting art work.

The ceiling proper is now patterned by five connected squares of light, each square bay measuring 16-by-16 feet, outlined by surface-mounted louvered 4-lamp Fullerton fixtures having translucent side panels. Lamps are 40-watt warm white preheat fluorescents.

Initial illumination on the surface of reading tables was 50-footcandles, while book shelves were lighted by intensities ranging from 42-fc on upper shelves to 25-fc on the bottom shelves.

This lighting installation, together with the selection of color, furniture and equipment, serves to effectively present to the public the Library's stock in trade—books. Every effort was used to make them stand out invitingly for the users. Walls above the book shelves are light green with ivory trim, the background for the printers' marks is yellow-green, the acoustical ceiling is ivory, and the flooring is natural parquet.

Experimentation is still continuing in the stack areas and a uniform lighting plan has not as yet been selected. However, one of several installations receiving consideration consists of continuous rows of 96T8 standard cool white lamps operating at 200 milliamps. Reflectors are DayBrite. This installation provides 50 vertical footcandles on the top shelves, 40-fc in the middle, 15 at the bottom. Ceilings in the stack sections are flat white, walls are light green and the flooring is tan composition tile.

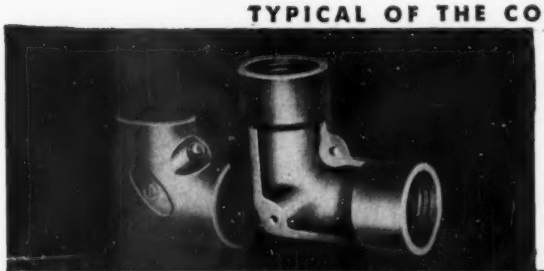
CONTESTANTS in the IES Southern Regional Conference "Most Interesting Lighting Job" contest at Greensboro, N. C. late in May were: S. B. LeCornu, Nashville Electric Service, Nashville, Tenn.; Earl J. Norris, Duke Power Co., Charlotte, N. C.; Harry T. Yopp, Georgia Power Co., Atlanta, Ga.; Mario G. Zervigon, L. N. Goodman Consulting Engineers, New Orleans, La. (winner of first prize); and F. G. Smith, Mississippi Power and Light Co., Jackson, Miss.

FOR CORNER PULL-IN ELBOWS, 3-PIECE CONDUIT COUPLINGS, PIPE STRAPS—CLAMP BACKS—NEST BACKS

GEDNEY *ALWAYS!*

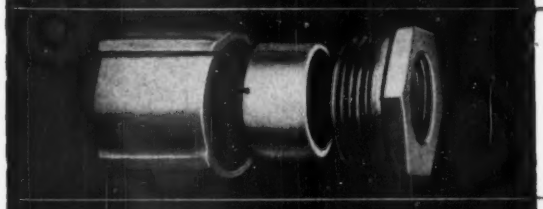
NATURALLY you want to cut installation time and costs. And you'll do it easily with Gedney Fittings, for these fittings are accurately machined and threaded, smooth finished, individually inspected to ensure top quality. What's more, Gedney Fittings are made of unbreakable malleable iron. For best profits, order Gedney always!

TYPICAL OF THE COMPLETE GEDNEY LINE ARE:



Corner Pull-In Elbows in ½", ¾" and 1" sizes. Ideal for space-saving, machine wiring, easy wire pulling. Cadmium plated.

Now available in 1¼", 1½" and 2" sizes



3-Piece Conduit Couplings in a large range of sizes from ½" to 6". Cadmium plated.

One-Hole Pipe Straps, Clamp Backs, and the handy new Gedney Nest Backs. These supplementary spacers nest firmly behind the Clamp Backs — use as many as you need to hold pipe at desired distance from wall. Hot dip galvanized to prevent corrosion.

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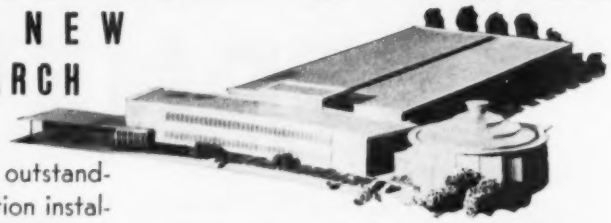
CONGRATULATIONS to FORD

ON THE BEAUTIFUL NEW ENGINEERING AND RESEARCH CENTER AT DEARBORN



Among the notable architectural features in this outstanding new building is the Smithcraft Area Illumination installation of overall lighting.

LOOKING OVER INSTALLATION IN DRAFTING AREA ARE PINGREE CONFLETTI, HARLAN ELECTRIC COMPANY SUPERINTENDENT AND J. S. ECCLESTONE, SMITHCRAFT REPRESENTATIVE.

. . . AND CONGRATULATIONS TO THE HARLAN ELECTRIC COMPANY OF DETROIT, ELECTRICAL CONTRACTORS

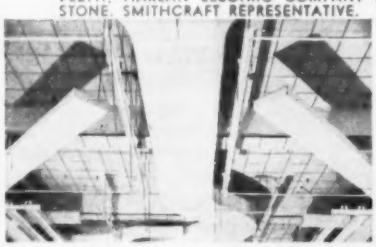
According to C. Allen Harlan: "Smithcraft Area Illumination has obviously been designed with the needs and problems of the electrical contractor in mind. It is almost unbelievably easy and efficient equipment to install". There's a real satisfaction in installing a Smithcraft Area Illumination system . . . satisfaction in the way the job goes together . . . satisfaction in the finished appearance . . . and satisfaction in excellent profits for a superior lighting job well done. One good installation leads to another . . . and to more and more sales. Smithcraft Area Illumination is **that good** both in its clean, trim, modern appearance and in its glare-free, low-bright illumination.

● ● ●

Once the hangers are in position on the ceiling, all you need is a level and a screwdriver. Everything goes in place quickly and easily with no careful dimensioning or critical locating of parts. Even the hangers are positioned almost haphazardly with an adjustment of 2" built right into the hangers. There's plenty of margin for error or for walls and ceilings that are not absolutely true.

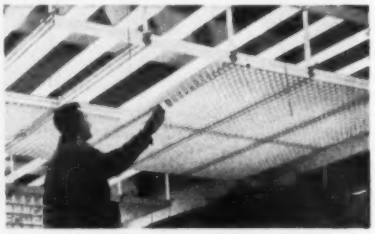
● ● ●

If you don't know about Smithcraft Area Illumination, investigate now. We'll be glad to send further information and any of the Smithcraft representatives throughout the country will be glad to tell you about it.

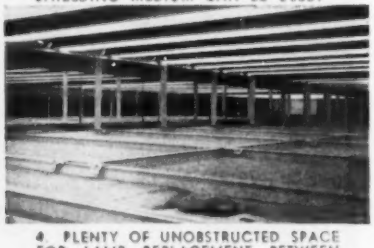


1. INSTALLATION COVERS NETWORK OF BEAMS AND DUCTS WITH MINIMUM OF SUPPORTS TO CEILING.

2. LAMPS ARE LIGHTED. FRAMEWORK FOR LOUVERED CEILING IS BEING INSTALLED.



3. INSTALLING LOUVERS. GLASS, PLASTIC, LENS . . . VIRTUALLY ANY SHIELDING MEDIUM CAN BE USED.



4. PLENTY OF UNOBSTRUCTED SPACE FOR LAMP REPLACEMENT BETWEEN SHIELDING AND ELECTRICAL ELEMENT.

There are three separate installations of Smithcraft Area Illumination in the Ford Engineering and Research Center with a combined area of more than 65,000 sq. ft. Intensities in the three areas are 112 footcandles, 100 footcandles and 108 footcandles.

Architects: Voorhees, Walker, Foley and Smith, New York

Electrical Contractors: Harlan Electric Company, Detroit

Distributors: General Electric Supply Company, Detroit

5. INSTALLATION CONFORMS TO CONTOUR OF BUILDING. ACOUSTICAL TREATMENT IS SUPPORTED ENTIRELY BY LIGHTING SYSTEM.

Smithcraft **LIGHTING DIVISION, CHELSEA 50, MASS.**

In The News

NISA Celebrates 20th Year at NYC Convention

900 delegates elect William Hogue of Los Angeles as 1953-54 president, select Detroit as next convention city and award prizes for practical motor repair methods.

THE National Industrial Service Association celebrated its 20th anniversary May 24-28 when 900 delegates attended the 1953 convention held in New York City's Hotel Statler. There they participated in instructive technical and business sessions, elected officers for the coming year, visited outstanding shops in the metropolitan area, browsed through 46 exhibits of products and services related to the repair field, and promoted friendships —old and new—during numerous committee meetings, association banquets and social interludes.

In his keynote address titled "Do Not Sell the Electrical Industry Short", L. W. McLeod, vice president, Westinghouse Electric, stated that "by 1980 the average work week will be 30 hours yet, with a labor force no larger than it is today, physical output will be up by at least 25% due to ever-lengthening strides being taken toward industrial electrification. Electrical equipment manufacturers have spent more than a billion dollars in expansion since the close of World War II", he declared, "and there is more than $100-billion worth of electrical equipment now in service. This equipment must be kept functioning efficiently—a fact which makes the motor repair industry a significant part of the national economy."

R. E. Ward, Sr., Electric Motor & Repair Co., Raleigh, N. C., discussed the layout, methods and operation of his modern shop, stressing the many progressive ideas practiced there.

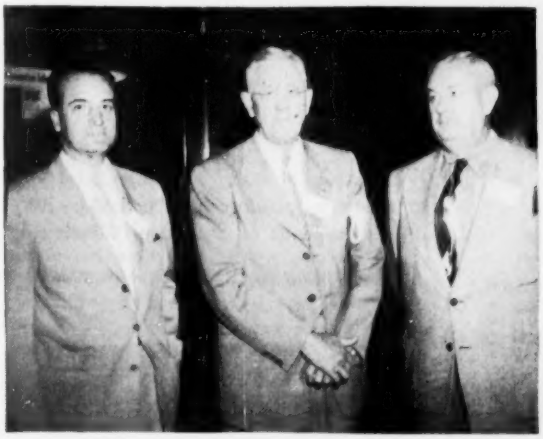
Paul Richards, of General Dynamics, discussed ball bearings and reasons for noisy motor operation. He strongly urged the use of instruments, analyzed frequency and the phenomena of sound, described methods for measurement and comparison, outlined procedures for locating cause and source of trouble, and prescribed methods for sound isolation and insulation.

J. L. Van Nort, Reliance Electric & Engineering Co., stressed simplification of motor drives, claimed higher efficiency by using individual drives rather than group motivation. He mentioned how motor characteristics and electrical adjustable speed mechanisms were being improved, stating that speed ranges of 100-to-1 were already practical realities. "The electric motor is an indispensable tool, doing many jobs well", he said. "In many cases it is the brain of a process, speeding up, slowing down, reversing, cycling, regulating or programming automatically. These automatic devices have low maintenance, low first cost, long life and convenient operation, and they are becoming more versatile as engineers learn more about design for explosive or corrosive atmospheres, and high ambient temperatures."

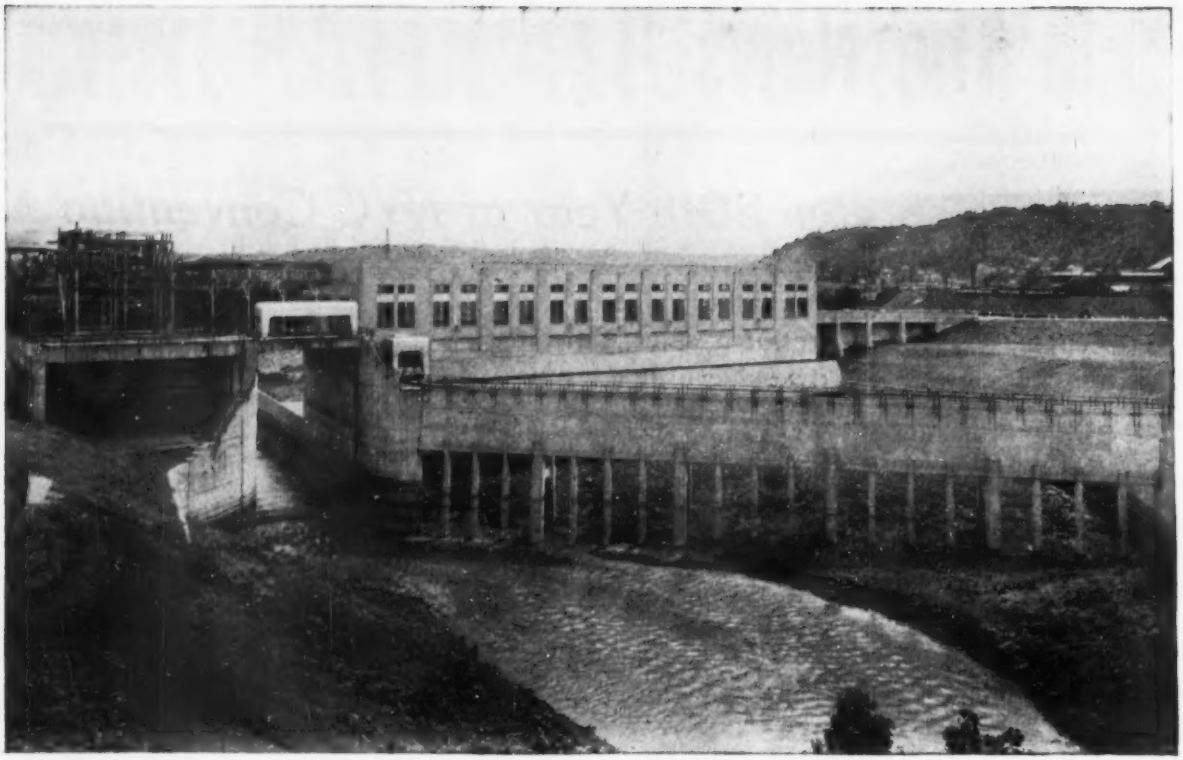
Richard L. McNeeley, speaking for Oscar Clot, Peninsular Armature Wks., demonstrated an inexpensive but accurate dynamic balancer for rotating equipment. He showed how it was constructed, operated and adjusted for various sizes of armatures, propellers or fans. "Motor applications have expanded so fast in the past 25 years," he summarized, "that dynamic balancing is a necessity in today's motor shop. And the use of a balancer will bring in more business, will guarantee a better job, will eliminate call-backs and contribute to greater profits."

K. M. Nelson, of Cutler-Hammer, discussed maintenance of motor controls.

Bill Wheeler of The Maintenance Co., New York City, N. Y. and Bill Hogue, Larson-Hogue Electric Co., Los Angeles, California.



W. Hall Grey and Bill Hanks of Southern Electric Service (Greensville, S. C., and Charlotte, N. C., respectively) and George W. Patterson, Patterson Electric of Toronto, Canada.



WE ALMOST PAID THE PENALTY!

"For the most part, our job was finished—except for one little item: installation of two 60¢ aviation lamps! That's where our headaches began," said Carl Birle of the Westgate Electric Construction Company, Electrical Contractor for the U. S. Engineers Dam Project in Cincinnati, Ohio.

"Our contract deadline was almost up; the penalty clause was about to go into effect; and all that prevented the completion of the contract was a $1.20 order. The lamps just couldn't be found!

"Fortunately, Wesco heard of our predicament".

A race against the deadline began. Wesco called the Westinghouse Lamp Division in Pittsburgh. Pittsburgh phoned the lamp plant at Bloomfield, New Jersey. The factory shipped the lamps air express to Columbus. Wesco met the plane and delivered the lamps . . . *under the deadline!*

In this case, the order totaled $1.20. It might have been $1,000,000. Wesco is equipped to handle jobs of *any* size. Backed by 30 years experience in the field, plus the resources of a nationwide organization, Wesco can offer your job the same dependable service.

Whatever your electrical problem may be . . . you can count on Wesco.

Westinghouse Electric Supply Co.

A NATIONAL DISTRIBUTING ORGANIZATION

40 WALL STREET, NEW YORK, N. Y.

Bill King, King Electric Motor Service, Miami, Fla.; W. E. Laycock, Laycock Armature Works, Tampa, Fla., and J. Lester Belcher, Jacksonville Armature and Motor Works, Jacksonville, Fla.

Meyer Friedkin, Electric Enterprise Co., N. Y. C.; Charlie Cannon, Nimmo Electric, Detroit, Mich., and Ed Potter, Lima Armature Works, Inc., Lima, Ohio.

Mike Zack, Zack Brothers' Electric Co., Mason City, Iowa, and George E. Jones, G. E. Jones Co., Inc., Amarillo, Texas.

I. M. Gross, Multi Amp Corp., Harrison, N. J., and Bob Ward, Sr., Electric Motor and Repair Co., Raleigh, N. C.

H. Q. Griffith, Belyea Co., Inc., Jersey City, N. J., and Lou Kennedy of New York City.

of various controllers. He showed how apparently complicated assemblies are really only groups of simple devices. "Inability to maintain them can usually be traced to a lack of study, training or aptitude on the part of the maintenance man," he stated, then illustrated this point by analyzing the various components, describing electron tubes and magnetic amplifiers in detail.

Shawley's presentation on synchronous motor control contrasted old manual starting methods with modern pushbutton means whereby polarized field-frequency control takes full charge of proper starting, applying field excitation, protecting and stopping the motor. He demonstrated, with the use of wiring diagrams and schematic charts, how polarized field-frequency control works, and compared results obtained with correct and incorrect synchronizing.

Non-Technical Presentations

In addition to these discussions on procedure, operation and maintenance, an interesting group of non-technical management papers was included. These topics covered "Insurance for Motor Shops" by R. J. Ford of the John T. Ostheimer Agency in New York City; "Partnerships vs. Corporations" by E. E. Burke, CPA for McCarthy and Burke of Jersey City, N. J.; "Human Relations in Industry" by Professor Ralph Campbell of Cornell University; "Warranty Service Contracts" by J. H. Previty, Penn Electric Motor Co., Philadelphia; and "Why You Need a Hobby" by Dr. Stephen D. Stephens of Rutgers University.

Ed Burke's paper included not only definitions of sole proprietorships, partnerships and corporations from taxation and business organization points of view, but from other personal and physical points as well. He showed that advantages and disadvantages of the several types of business organization can fluctuate with conditions and should be re-analyzed every few years to verify that these conditions remain constant.

In discussing human relations, Professor Campbell pointed out that employees work for various reasons, such as their desire to find freedom from hunger or discomfort, their wish to be accepted as a useful member of society, or their desire to create or maintain. He defined leadership as "the ability to influence people to work towards a common goal" and stated that leadership is not necessarily an attribute of either management or ownership. If cooperation between management and labor is not as high as desired, he advised management, "Don't check up on your employees. Check up on yourself. Take a sincere interest in others. Take time to get the facts before acting. Be a good listener with an open mind for suggestions. Accept complaints as helpful ideas. Keep your promise at all times. Admit your mistakes. Commend your employees when they deserve it. Take prompt action when a decision has been reached."

Joe Previty stressed the fact that a warranty service contract is more than

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ENGINEERED FUSES
for dependable
protection

ROYAL-NOARK
NON-RENEWABLE
5
ways better
on the
inside

use them on
EVERY JOB

ROYAL-NOARK
RENEWABLE
easiest
to
renew

Engineering improvements in the design and construction of ROYAL-NOARK cartridge fuses mean that they stay cooler . . . give greater protection to vital equipment.
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ROYAL Quality
WIRE • CARTRIDGE FUSES
famous ROYAL "Crystal" PLUG FUSES
ROYAL ELECTRIC CO., INC. PAWTUCKET, R. I.

Chet Tanner, Industrial Motor Service, North Tonawanda, N. Y., and A. O. Kleen, The Electric Service Co., Inc., Austin, Texas.

just an agreement between a motor repair shop and a motor manufacturer covering repairs which become necessary during the period of guarantee. "The authorized shop must have the necessary equipment and ability to do a good job, must possess a good working knowledge of the motor repair business, must be set up to handle emergency repairs, carry spare motors, have an adequate supply of parts, keep good records—especially of receipts and shipments. They should have accurate electric meters which are frequently calibrated, a safe means for measuring insulation resistance, balancing equipment for checking rotors, and fundamental tools and machinery of a first class shop."

The History of NISA

At the Wednesday morning session, William J. Wheeler, Sr., president of The Maintenance Co., New York City, and a past-president of NISA, reviewed "The Past History of the NISA and Its Promise for the Future", citing the steady growth of the association during its first two decades to its present membership of 1335. He mentioned various milestones reached during this period: how NISA was born out of a necessity for electrical and mechanical shops to form a cohesive organization during the days of the NRA, how various individuals advanced personal loans as an initial working fund, how the motor standards code was developed, how legal council was sought and how the organization has aided members through data cards, technical information, report forms, rewiring data, bookkeeping forms, award contests for shop methods, meetings of chapters, regional and national groups, the development of the "open door" policy, the creation

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RIGHT CONTACT
for dependable
wiring devices

CAPS

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CONNECTORS

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use them on
EVERY JOB

No. 43
"ROYALOK"
RECEPTACLES

No. 99

Sound engineering, quality materials, and experienced manufacturing skill make ROYAL wiring devices better for you these three ways: 1) they're easy to wire; 2) always dependable; and 3) long life under constant use.
. . . ask your wholesaler

ROYAL Quality
WIRE • CARTRIDGE FUSES
famous ROYAL "Crystal" PLUG FUSES
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Compare

See how Life-Line Starters give you a better installation on every job

The time required to install starters can make or break your job profit. That's why it pays to compare Life-Line Starter with any other motor control for easier installation—on every job.

1. ***Deep-drawn, lift-off*** cover exposes more of the mechanism—speeds wiring. Plenty of knock-outs, too, for easy conduit connections.

2. ***Straight-through wiring*** saves wire, saves time, eliminates hunting for "missing" terminals. Line terminals at the top, load terminals at the bottom—all plainly marked—all front-accessible.

3. ***Pressure-type connectors*** end looping of wires and provide quickly made, low-resistance connections for either solid or stranded wire.

4. ***NEMA standard mounting*** dimensions and wiring sequence eliminate guesswork.

Customers get a break with Life-Line Starter, too. Simplified design and rugged construction combine dependability with exceptionally low maintenance over millions of operations.

For complete facts, see your Westinghouse Representative or write for DB 11-200, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-30158

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drills 6 inches of concrete per minute

...gives lowest cost per foot of concrete drilled with a

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Patented core slot expels cuttings automatically

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Drill straight, clean, ready to-use holes at speeds up to 6 inches per minute—even through steel reinforced concrete. TILDEN Rotary Koncrete Kore Drills can be used with ordinary electric or rotary air drill. Free Factory sharpening and repair service still available on all Standard TILDEN Drills from 3/16" to 8-inch diameters. Interchangeable shanks for any depth hole.

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Harry Bedig, Electric Maintenance Co., and Fred Ferris, Northeastern Electric Co. (both Boston), and Chris Dulsen, Central Electric Co., Cambridge, Mass.

of NISA News and the distribution of timely bulletins on national subjects.

Bill Wheeler's review was augmented by reports presented by president R. A. Scherer, Indianapolis, and executive secretary Fred Wipperman of Saint Louis. These reports further showed what progress had been made by members in customer and employee relations, advertising, salesmanship.

Rounding out the series of forums, C. G. Frei of the General Electric Company stressed "Productive Maintenance"; D. H. Lory of Allis Chalmers posed the question "Is Electrical Equipment Part of Your Life", and Walter Hugger of the Sun Chemical Corp., Nutley, N. J., told delegates to "Harness Those Work Horses".

"Industry is rapidly recognizing that in order to expand economically to meet demands, it is necessary to provide man-power with strong aids to do the job", said Frei. "More machines are therefore being provided, utilizing more kilowatts per man hour. Refinements in design have improved operating economy and many improvements have been made in manufacturing methods. With all this, the maintenance of electrical equipment has become a very important factor in effective plant operation because of the serious effect of equipment failures on production. To all of us in the service business, this presents a challenge and an opportunity." This premise was backed by a discussion on the importance of plant maintenance, management's approach to maintenance, financial control, the purpose and place for maintenance in industry, budgets, personnel, records and stock requirements.

In Mr. Lory's discussion, he mentioned that motor manufacturers with local service shops acting as certified repair agencies for their products

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USE G-E METER SOCKETS

- Baked-on aluminum Glyptal® for long life.
- Tin-plated bronze terminal clips for low-resistance contact.
- Stainless-steel ring to reduce corrosion.

Contact your nearest G-E sales representative or write General Electric, Schenectady 5, N. Y. 601-90

There's a G-E Meter Socket for Every Application.

GENERAL ELECTRIC

1893 60th Anniversary 1953

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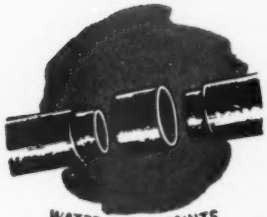
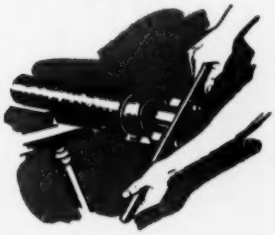
LIGHT - EASY TO HANDLE

CUTS WITH SAW



WATER TIGHT JOINTS

5°36'R BEND SECTIONS TO MEET SPECIAL RADIUS APPLICATIONS IN THE FIELD



EASY TO TOOL

ORANGEBURG NOCRETE

NEW BASE SPACER

COMPLETE LINE OF INTERLOCKING PLASTIC SPACERS

ORANGEBURG STANDARD

Many Reasons Why Contractors Prefer Orangeburg Fibre Conduit

Orangeburg's *time-saving* advantages help the contractor to make money on every job. Its light weight speeds handling. It is easily sawed, drilled, and worked in the field. Just a few taps set up a permanently tight joint. For these and other reasons, Orangeburg lays faster and at lower cost than any other type of conduit.

And once installed Orangeburg provides complete and permanent protection for the underground cables that supply so many electrical services.

These advantages have created an acceptance that keeps Orangeburg a leader in every city and state.

Orangeburg Conduit is clearly identified by its registered trademark. Make sure it's on the conduit *you* install. For illustrated folder of Orangeburg Bend Sections and Angle Couplings, write Dept. EC73, Orangeburg Manufacturing Co., Inc., Orangeburg, New York.

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FIBRE CONDUIT

STANDARD INSTALLED WITH CONCRETE

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THE AD MAN WAS FLABBERGASTED

RAWLPLUGS
Fibre screw anchor for use with wood or lag screws. Only universal anchor that can be used in any material.
Wood screw sizes #6 to #20
Lag screw sizes #3/8 to #5/8

RAWL-ANCHORS
Heavy duty masonry anchor of "confined lead type" for holding bolts. Made in one piece—double ended—cannot be misapplied.
Bolt sizes 1/4" to 1"

RAWLDRILLS
Three point easy-to-sharpen masonry drills for hand and power drilling. For Rotary drilling—use Rawl Carbide tipped drills.

RAWL-TAPERS
The improved machine screw anchor. The taper permits use in undersized holes, resulting in saving of drill costs.
Machine screw sizes—6 x 32 to 5/8 x 11

RAWL-DRIVES
Only expansion bolt combining anchor and bolt in one piece. Simple to use, easy to install. Drives like nail into drilled hole. Tremendous holding power.
Sizes 3/16" to 5/8"

RAWL HAMMER-SETS
Newest type of heavy duty machine bolt anchor. Hammer is only tool needed to set it permanently in the masonry.
Bolt sizes—3/16" to 5/8"

RAWL TOGGLE BOLTS
For simplicity of installation and security of anchoring any fixture or utility in hollow walls or ceilings.

THIS AD MAN had spent 20 years dealing with the technical facts of industrial products. He knew most of the angles and their answers. Shown a small Rawlplug, he figured it could resist a "pretty strong pull."

SURPRISE!

Then we gave him a demonstration... a #12 Rawlplug with a #12 screw set in concrete. Attaching a jack and scales we applied a direct pull. Up went the indicator... 500, 1000, 1500 lbs. The Rawlplug held firm. We applied more pull, and still more, till finally the plug started to creep. The indicator stood at 2200 lbs. and the ad man was flabbergasted!

EVERYTHING!

The fact is, that Rawlplugs and other Rawlplug devices are absolutely tops for holding power... have a safety factor many times in excess of most anchoring requirements.

And on top of that, the famous Rawlplug line is *complete* and enables you to meet virtually every anchoring demand of every customer and prospect.

YOU WIN!

The Rawlplug line is sold only through distributors. The line is constantly being developed... and effective advertising describes its unique advantages to everyone who counts in your area.

Write for the whole Rawlplug story... it can boost your sales and win brand new friends.

THE RAWLPLUG Co., Inc.
271 Church St., New York 13, N.Y.

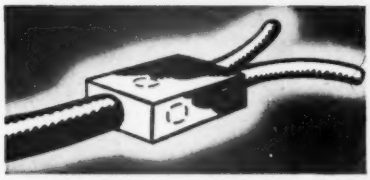
Al Bonahur, S. J. O'Brien, Inc., N. Y. C., and NISA's Executive Secretary Fred Wipperman, Saint Louis, Mo.

should have a two-way agreement with them. The manufacturer should keep all information confidential, grant the service shop the right and authority to advertise itself as a certified repair station, have repair parts available at special terms, meet all delivery requirements, warrant parts to be free of defects in material and workmanship, furnish the service shop drawings and all information deemed necessary to repair or service specified products, and advertise the shop through the company's regular advertising channels. In turn, the certified shop should permit inspection of their facilities by the manufacturer, permit the company to inspect its work, establish a complete schedule of standard competitive charges, use only company-made repair parts on brand motors, furnish performance reports to the company, keep drawings and other data confidential, perform all repairs in accordance with company standards, maintain adequate insurance coverage, never misrepresent or bind the company falsely and discontinue the use of the company's name if the agreement is terminated at any time.

In defining work horses for motor shop use, Mr. Hugger told shop owners to improve their contacts with their customers, promote their services by telling, showing and demonstrating—using loose leaf binders containing pictures of jobs completed, mailing pieces, data sheets, letters of commendation, views of their shops and equipment in use. He mentioned the value of a direct mail program.

At the annual business meeting, it was announced that NISA officers for the coming year were president William M. Hogue, Larson-Hogue Electric Co., Los Angeles, Cal.; vice president G. E. Jones, G. E. Jones Electric Co., Amarillo, Tex.; secretary J. H. Previty, Penn Electric Motor Co., Philadelphia, and treasurer C. R. Durand, H. N. Crowder Co., Allentown, Pa.

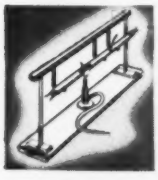
How to get longer life out of your portable cords and cables!



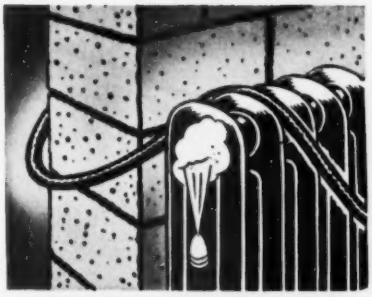
1 **USE** junction or distribution boxes for making multiple power connections in working places.

2 **PROTECT** cables with fuses or circuit breakers of the proper rating for the service. Make sure that circuit breakers will operate properly.

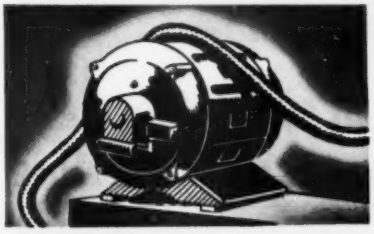
3 **PROTECT** cables from being run over by heavy equipment. Running over the cable a few times may not cause immediate failure, but may do internal damage which will shorten its life. If the cable must be run across an aisle, place boards on either side as one would for a hose. If it is in use for only a short time, it should be thrown over the truck.



4 **USE** flame-resistant cables wherever possible.

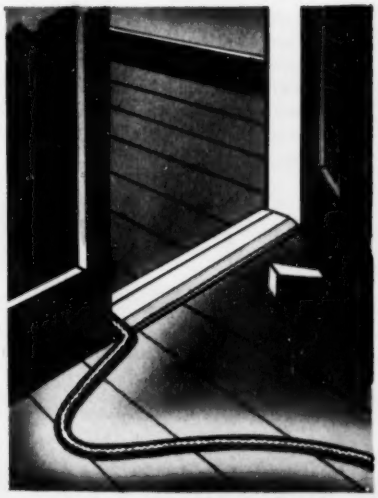


5 **DO NOT** have portable cords and cables running over steam pipes or other heat-transmitting equipment.



6 **KEEP** cables away from sparking motors and high voltage equipment. The ozone generated by sparking commutators attacks rubber jackets, causing cracking.

7 **AVOID** overloading of cables. Where possible, use I.P.C.E.A. recommended current ratings.



8 **AVOID** dragging portable cords around rough edges or sharp corners. Bruises and cuts hasten deterioration of the jacket. Never yank cords to remove kinks or loosen them when caught on a projection.

9 **AVOID** running portable cables on pulleys or drums too small for the size of the cable; observe recommended I.P.C.E.A. minimum diameters.

10 **KEEP** cords away from oils and greases. If they do get into oil, they should be wiped off as soon as possible. Avoid having cords lie in pools of water, chemicals or grease.

11 **BUY** cables that can carry the required current without overloading or overheating. They should be flexible (have sufficiently fine strands) for the intended use.

FOR FREE REPRINTS OF THIS PAGE, WRITE TO ADDRESS BELOW.

UNITED STATES RUBBER COMPANY

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SERVING THROUGH SCIENCE

Electrical Wire and Cable Department

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In addition to the large stock of motor and control renewal parts for which we are widely known, we also carry a complete line of supplies for motor re-winders.
Any of the wide variety of materials you need to rebuild electric motors can be obtained from our complete warehouse stocks at rock bottom prices.
Look in the Supplies section of our new Catalogue for further proof that you can buy everything you need for the repair and maintenance of electric motors and controls from one source of supply.

Write for Catalog...

COMPLETE READING ELECTRIC CO., INC.
102 SOUTH JEFFERSON STREET • CHICAGO 6, ILLINOIS
"Your Best Source of Supply"

A Journeyman's Tool, built to stand up under constant, on-the-job Contractor or Industrial use

● **NO STARTING HOLE NEEDED**...Simply place guide next to material and "rock" tool into an upright position.

● **CUTS RIGHT THRU IMBEDDED NAILS** . . . wood, plaster, iron pipe, sheet metal, "Transite" and most other materials—even in cramped quarters.

● **FITS ANY HEAVY DUTY ¼" or ⅜" DRILL**...as easy as changing bits! Overall length only 10¾"; weight only 3 lbs. 6 ozs.

● **ANTI-FRICTION REPLACEABLE BEARINGS—BUILT-IN BLOWER** . . . Blower keeps tool comfortably cool even under continuous use—blows dust and chips away from cutting line. All friction surfaces are of "Oilite," phosphor bronze or high speed ball bearings. All wearing parts are replaceable.

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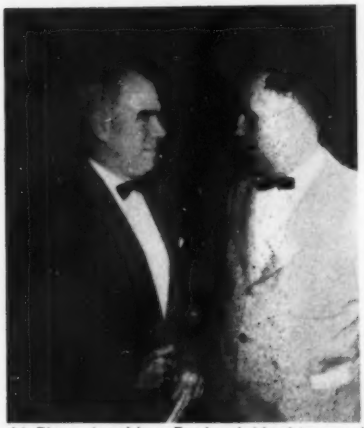
Cutting opening in oak flooring in less than 3 minutes—no starting hole needed!

R.C.S. TOOL SALES CORPORATION Joliet, Illinois, U. S. A.

Federal Procurement Officials will find Super Saws listed in Federal Supply Schedules, Class 40 Materials.



Al Elson Jr., New England Machine and Electric Co., Pawtucket, R. I., and Jack Reddington, J. J. Reddington Electric Service Co., Boston, Mass.

It was also announced that next year's convention would be held in Detroit, April 11-14, 1954, and that the annual Methods Award Contest had attracted 74 time-and-money-saving ideas from shop men all over the country. These ideas included a hook for lifting motors into a car trunk (first prize), varnish drip pans to fit on baking oven trucks (2nd prize), a slip-sleeve method for insulating coil group connections (3rd prize), and a method for converting a monkey wrench into a convenient spanner (4th prize). Honorary mentions and awards went to ten others for such ideas as a machine for forming rotor bars, a form for bundling scrap copper wire, a sleeving gage, turntable for stator winding, turnbuckle wedge for large open slot motors, rotary tool for boring oil grooves, calipers adapted for measuring stator core diameters, a chuck converted as a centering device and a method for soldering commutators.

In between sessions, delegates were invited to visitations of motor shops in New York and northern New Jersey, a boat trip around the island of Manhattan, a theatre party to 3-dimensional "Cinerama", the president's reception, a business luncheon and the final banquet at which F. W. Willey of the Willey-Wray Electric Co., Cincinnati, served as toastmaster, and Clayton Rand, editor of the Dixie Guide, Gulfport, Miss., entertainingly looked into "The Next Million Years".

This convention was under the direction of general chairman H. Q. Griffith, Belyea Co., Jersey City, N. J.

Technical and forum chairmen were W. M. Hogue, Larson-Hogue Elec. Co., Los Angeles; H. E. Grant, Tennessee Elec. Motor Sv., Nashville; W. S. Giles, Giles Armature & Elec. Works, Marion, Ill.; J. A. Turner, Sr., Tan[illegible] Armature Wks., Tampa, Fla.

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Trumbull Circuit Breakers for load centers, panelboards, switchboards, for industrial, commercial and residential applications, provide greater safety to operators, better circuit protection against both shorts and sustained overloads. They pay off in convenience, permanence and fast restoration of service.

Available in ratings from 10 to 600 amperes and voltages up to 600 volt AC, 250 volt DC, either open type or with surface or flush-mounted enclosures, of semi-dust-tight, water- and dust-tight design. Accessories available for conversion to non-automatic, remote tripping, bell alarm and other special requirements.

Trumbull Circuit Breakers and breaker-equipped load centers, panelboards and switchboards, plus the advice of qualified Trumbull sales engineers, are available through leading Distributors everywhere. Write direct for literature or technical information.

Trumbull AT enclosed circuit breakers feature "trigger" trip, automatic tripping, silver-alloy contacts, individual calibration. 2- and 3-pole construction, from 15 to 600 amperes, 125 to 600 volt AC or 125 to 250 volt DC. Single pole available in 50-ampere frame size breakers, 125 volt AC or DC.

Trumbull TQL (plug-in) and TQ Circuit Breakers feature *both* thermal and magnetic protection, "trigger-type" quick-make and break, trip-free operation, trip-indicating handle, silver-plated contacts, arc-quenching chamber. Individually calibrated and sealed in compact, dead front phenolic cases. Ratings: 10 to 50 amperes, 120 volt AC, single pole.

TYPE TQL TYPE TQ

Trumbull K-173 Marine Hi-Shock Circuit Breakers, 3-pole, 125 volt AC or DC, 50 ampere frame size. Suitable for protection of lighting mains, feeder circuits, single load circuits supplying motors, radar, sonar, etc.

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EASY TO INSTALL . . .
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Reliance Time Controls

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- 30 Ampere capacity at 125/250 volts
- Accurate, dependable circuit control

MODEL "W" ASTRONOMIC TIME SWITCH

The Reliance Astronomic time switch has these advantages over standard switches. It automatically advances or retires the "ON" trip daily to correspond with changes in sunset time. Eliminates manual resetting.

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TYPE W-33 time switch, with special 2 circuit control is equal to two single pole time switches in one. It will control two separate circuits independently or simultaneously by setting trippers to desired schedule. Provides 8 different combinations of two-circuit control, or operates as a double pole, single throw switch.

RELIANCE AUTOMATIC LIGHTING COMPANY
1937 Mead St. Racine, Wis.

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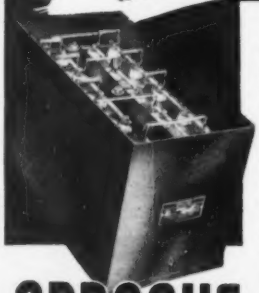
HOW TO SAVE ON POWER BILLS

...also on wiring, switchgear and transformer costs!



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NECA District No. 1 Met in Groton June 1-3

Discussions on creative selling, business development, labor relations, apprentice training, market research, and a tour of the U. S. Naval Submarine Base at New London, were highlights of the program of the seventh annual meeting of District No. 1 of the National Electrical Contractors Association. The meeting was held at the Griswold Hotel, Groton, Conn., on June 1 to 3. Over 300 members and guests enjoyed the program arranged by Theodore D. Bross of Hartford, Conn.

Alfred V. Bartlett, Sr., Rust Electric Co., Providence, and a vice president of NECA, presided at the general sessions. In his opening address, Mr. Bartlett gave a report of the progress of the various NECA activities since the last convention. 'Business development and governmental affairs' were discussed by John L. Rose, managing editor, *Qualified Contractor*. He stressed the importance of creative selling by electrical contractors and the need for developing new sources of business. W. A. Brown, assistant manager, The Travelers Insurance Co., pointed out what to look for in purchasing various insurance coverages applicable to the electrical contracting industry.

A report of the pension plan after six years of operation was given by W. D. Howell, assistant secretary-treasurer, National Electrical Benefit Fund, Washington, D. C. He said that 10,537 contractors reported in the last quarter. Frank Crimp, architect, Adden, Parker, Clinch & Crimp, of Boston, spoke on the architect and his relationships in the construction field. Jules H. Friedland, Lightning Electric Service Co., Newark, discussed the danger of "Hold Harmless" clauses in contracts.

The NECA Research and Cost Data

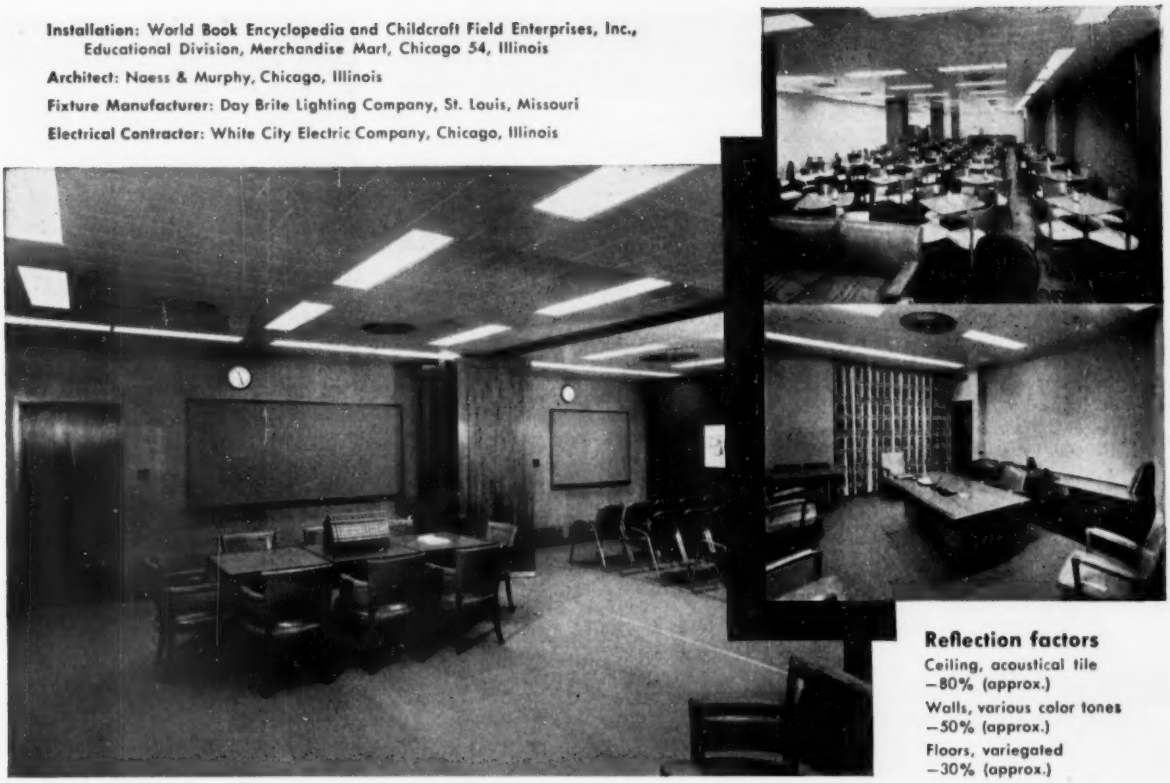
A. V. BARTLETT, SR., Vice President, NECA, with J. W. Werther, Werther Electrical Contracting Co., New York during the District No. 1 meeting in Groton.

Installation: World Book Encyclopedia and Childcraft Field Enterprises, Inc., Educational Division, Merchandise Mart, Chicago 54, Illinois

Architect: Naess & Murphy, Chicago, Illinois

Fixture Manufacturer: Day Brite Lighting Company, St. Louis, Missouri

Electrical Contractor: White City Electric Company, Chicago, Illinois



Reflection factors

Ceiling, acoustical tile —80% (approx.)

Walls, various color tones —50% (approx.)

Floors, variegated —30% (approx.)

The *right* lightingware *accents* striking design

Nothing has more influence on the design of an office and the morale of its employees than the appearance and performance of lighting glassware.

Take, for example, the World Book Encyclopedia and Childcraft offices in Chicago's Merchandise Mart.

Here, fresh, modern and inviting furnishings show at their best under attractive, efficient Corning engineered Unilite lens panels.

Soft, even, over-all light eliminates shadows. Fixture brightness and glare are minimized. Water-white crystal lenses transmit true color from the light source.

More than 1¼ miles of glass panels — in approximately 1600 four-foot, two-lamp troffers — light 66,000 square feet. Average illumination levels are 60-foot candles maintained (at no place could less than 50 f.c. or more than 70 f.c. be found).

Lens panels offer other advantages, too. Installation is easy and economical because of their light weight. And, being glass, Corning lens panels cannot fade, warp or discolor as other materials often do. They add to appearance whether lights are on or off.

Unilite lens panels are only one of several types of Corning engineered glass lightingware. You can also achieve distinctive effects with combinations of flat and curved Twinlite lens panels, Alba-Lite, Fota-Lite, Crysta-Lite and Lenslites.

Bulletin LS-32 and the photometric data sheets contain a host of ideas. Send for them today. Mail the coupon.

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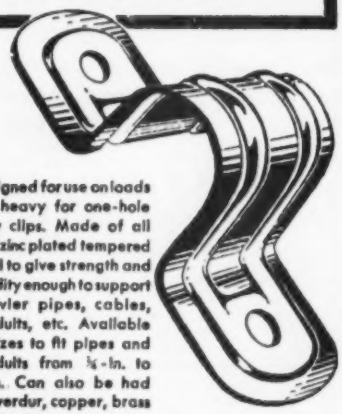
For Heavier Loads!



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Control MAXIMUM PRODUCTION

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1% Accuracy for any range from 30 to 100,000 RPM or surface speed.

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DON B. CLAYTON, president, NECA, and H. A. Webster, T. Frederick Jackson, Inc., New York City attended the NECA District No. 1 meeting at Groton.

Program was outlined by E. R. Cornish, director, Research & Education, NECA. He said that the manual of labor units is now in the process of revision, an analysis of the markets and potential markets of the electrical construction business is being made.

S. J. Cristiano, eastern regional director, NECA, spoke on the relationship between management and labor. He stated that NECA is making a survey of labor agreements by contractors throughout the country and this information will be made available to each chapter. What the electrical contractor wants, has at the present time and needs in the future was spelled out in detail by Paul M. Geary, Executive vice president of NECA.

H. W. Memmott, industrial sales manager, the Connecticut Light and Power Co. spoke on the opportunities for the electrical contractor in the power expansion program. He also discussed the all electric factory. William Damon, director of the Apprenticeship Program, stressed the need for apprentice training and outlined the program established jointly by NECA and IBEW.

Don B. Clayton, president, NECA, reported on the various activities of the committees of the association and commented on the progress that is being made. Six resolutions were presented by H. A. Webster, T. Frederick Jackson, Inc., New York City.

Jacksonville Contractors Elect Officers

Clyde Morgan of Morgan Electric Co., has been elected president of the Jacksonville Electrical Contractors Association, Inc. R. L. Mulligan of Mulligan Electric Co., was named vice-president, and W. O. Henderson of Henderson Electric Shop, secretary-treasurer.

Directors elected included D. L. Carroll, S. E. Lee and W. W. Masters.

Whatever your Lighting Requirements...

THERE'S A *Wheeler* FIXTURE THAT'S RIGHT FOR YOU *and the* JOB!

FLO-LINER *for* **COMMERCIAL LIGHTING**

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Name your installation — there's a Wheeler Fluorescent Fixture to give you maximum lighting efficiency! For 72 years, Wheeler has adhered to the standard of manufacturing only quality lighting fixtures — engineered for ease of installation and proven maintenance savings.

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No other
Vapor-tite Fitting
offers so much!

- Versatility—4 hubs, 3 plugs
- Resilient neocork gasket
- Strong socket, big terminals
- Globe—clear, colored, heat resisting
- Cast guard with safety groove

. . . . *and it can't rust—it's "Adalloy"—lowest maintenance.*

Reflectors in all types
Bulletin E-5-52

THE ADALET MANUFACTURING CO.
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J. Walter Collins

J. Walter Collins, 69, executive-secretary of the Electrical Contractors' Association of City of Chicago and manager of the Chicago and Cook County Chapter, NECA, died May 15 at Oak Park, Ill., following a heart attack. Practically his entire business career was devoted to the electrical construction industry. He was secretary of the contractor group for almost 40 years. Previous to that, he was associated with the Hub Electric Company —a Chicago contracting firm which specialized in residential wiring. It was during this time that Mr. Collins developed the "Four-Unit System" of estimating residential electrical wiring —one of the first progressive moves away from the "per outlet" estimating practice. His continued interest in adequate wiring led him to develop the patented "Collins Outlet Planner", a simple device for layout of convenience outlets in residences.

During his association career, Walter—as he was known to the electrical contracting fraternity—maintained a keen interest in estimating and job management practices. He initiated (with the cooperation of association officers and members and the Chicago Electrical Estimators' Association) some of the most extensive cost surveys and research studies ever made in the industry. This work had such far-reaching influence in the industry that the research activities of the Chicago association were subsequently absorbed by the National Electrical Contractors Association. Mr. Collins gained national recognition for this work in 1947 when he won the James H. McGraw Award for his contributions to the electrical industry. He was also considered an authority on labor-management relations and the agreements he initiated with the local electrical workers union reportedly served as a pattern in many building trades.

Book Reviews

New Edition of Electrician's Handbook

A seventh edition of the "American Electricians' Handbook" by Terrell Croft, Consulting Engineer, revised by Clifford C. Carr, Head of the Department of Electrical Engineering of Pratt Institute, is now available. This comprehensive reference book for practical electrical workers, for years the outstanding text of its type, has been fully revised in accordance with the 1951 National Electrical Code. Its scope has been enlarged and brought up to the

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Makes any cutting job quick . . . easy . . . economical

Zips through wood, metal, lath, plaster, pipe, ebonite, fiber—cuts openings for electrical outlets, fuse boxes, etc. No electrical contractor can afford to be without it.

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It takes just a handful

OF T&B LOCK-TITE CONNECTORS

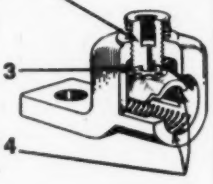
to tap . . . terminate . . . or splice on all your jobs

1 Easy installation using only a standard key wrench.

2 Fitting operates on screw-and-saddle principle.

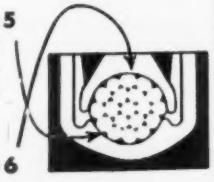
3 Built-in lock washer keeps fitting tight.

4 Serrated saddle and body for better grip.



5 Force applied here is greatly multiplied by leverage screw . . . gives tight all-around grip on cable.

6 T & B designed saddle securely holds large cables or small cables of all types.



T & B Lock-Tite fittings are engineered for long service . . . they cost you less to install— be sure to use them on your next job.

LOCK-TITE LUG

One-piece design holds all kinds of conductors: solid, stranded flexible, extra flexible, hemp core, rod, and tubing. Uniform all-around pressure means high conductivity. Only 7 sizes handle all cables from #4 solid to 1000 MCM.

LOCK-TITE TEE-PARALLEL TAP

A versatile, one-piece fitting for use as a tee, parallel, elbow, crossover, two-way, or reducing connector. Hinged top hooks over the "main"...lower opening holds the "branch". Only 13 sizes connect all combinations of "main" cable (1/0 to 1000 MCM) to "branch" cables (#2 to 1000 MCM).

LOCK-TITE TWO-WAY CONNECTORS

Neat and smoothly-rounded fittings for end-to-end connections. Cables are held by individual overlapping, serrated saddles. Each connector takes several cable sizes—you can use it as a reducer. The completed joint is small, streamlined, easy to tape. Only seven sizes handle all cables from #4 solid to 1000 MCM.

TWO other handy, T & B pressure connectors

HINJON JUNIOR TEE-PARALLEL TAPS

Compact, one-piece connector taps small branches to large mains. Self-adjusting jaws grip main and branch cables all around. To make a tee tap, just bend the branch wire at right angles. Installed easily with only a screw driver. Twelve sizes connect all combinations of "main" cables (#8 to 1000 MCM) to "branch" wires (#14 to #1).

LUGITS—Quickly installed terminals for small cables. Double thickness at the thread locks the screw in place. Copper tongue is serrated for positive grip on cable (sizes #14 to 4/0). Screwdriver tightened.

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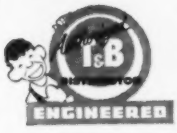

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★ ENDS SLOW HAND WORK
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Modernize now for profit's sake! You form far more coils in less time — eliminate drudgery as well. Insures customer satisfaction on every job. A proved time and labor saver in shops everywhere, the P & R High Speed Taping Machine quickly pays for itself; goes on year after year saving you money. Convenient time payment plan. Available for floor mounting as shown or for bench mounting.

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latest accepted standards for the selection, installation, operation, care and proper application of electrical apparatus and supplies.

Covering everything from the fundamentals to the finest detail of practical electrical work, this ready-to-use guide is based on sound engineering principles and practice. Designed as an authoritative job-book for the apprentice electrician or the experienced engineer, the 1773-page volume covers the widest possible range of electrical subjects, of interest to wiremen, contractors, linemen, plant superintendents, operators and construction engineers.

The complete book is presented in 11 divisions, including: Fundamentals, Properties and Splicing of Conductors, Circuit Calculations, General Electrical Equipment and Batteries, Transformers, Electron Tubes and Circuits, Generators and Motors, Outside Distribution, Interior Wiring, Electric Lighting and Wiring Tables. This text is supplemented with thousands of illustrations: sketches, graphs, photographs, circuit diagrams and tables. A 35-page index in the back of the book completely and clearly breaks down various subject matter for easy reference. Authoritative information is presented on such up-to-date subjects as: construction, operation and application of electronic devices in industry; control generators (Amplidyne and Rototrol); electronic control of motors; automatic drive controls; synchros; dry-type rectifiers; load center distribution systems; and farm wiring.

The 7th Edition of "American Electricians' Handbook" is published by the McGraw-Hill Book Company, 330 West 42nd St., New York 36, N. Y. The price per copy is $10.00.

Supplementary Lighting

Good current industrial lighting practice calls for adequate levels of general illumination well diffused throughout the entire work area. The recommended lighting intensities vary according to the severity of the visual tasks existing in each area. This practice has evolved through the years with considerable effort, from the early concepts of using individual light sources installed in close proximity to the work task to be seen. This earlier practice was eventually described as "local" lighting, as efforts were finally made to provide "general" lighting for entire work areas. In the effort to standardize on general lighting for industrial areas, the lighting industry has more or less condemned "local" lighting to the extent that most plant

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"Just a Twist of the Wrist"
THE NEW
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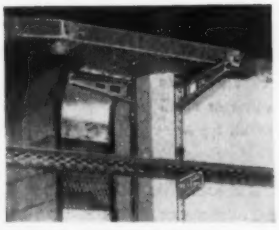
RAKIT®

Rakit, the easiest-to-assemble system of supporting structures ever devised, now offers a revolutionary one-piece bracket. This features even greater simplicity of installation by the twist-of-the-wrist method with more assembly time saved. No bolts, nuts or other fasteners are required.

The many savings in assembly time and labor afforded by the new one-piece Rakit assures "greater support at less cost." Write today for complete details.



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Internal Curing Type Of Varnish Results in Complete Drying and Integrated Windings

Conductors are held in a compact homogeneous mass, free from wet, tacky interiors when impregnated with any of Irvington's internal curing varnishes.

These varnishes assure deep penetration and thorough curing, while at the same time permitting the use of fast, money-saving baking schedules. Range of types available permits selection to meet specific requirements such as: high oil and heat resistance; complete oilproofness; exceptional mechanical strength; long life at high temperatures; extreme resistance to chemical attack.

Motor repair shops dip stators and armatures in Irvington's internal curing varnishes for deep penetration, fast curing throughout and strong conductor bonding

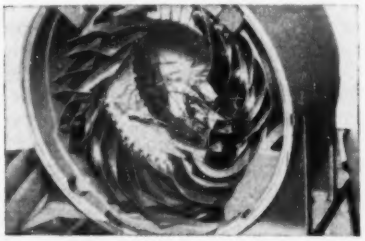
Special Binder Used in Slot Insulation

A newly developed binder for bonding a fibre backing to flexible varnished insulation makes it possible for Irvington to produce a slot insulation with mechanical strength needed to withstand forming to fit any type of motor slot. Used in Irvington's IRV-O-SLOT cell insulation, this binder has the "give" necessary to prevent rupture of the varnish film during the forming operation. The binder does not harden with age nor ooze out under the effects of heat. Both shelf life and service life are greatly increased.

Motor Repair Shops Face Growing Demand For Rewinds with Class "H" Insulation

Design Trend to Use of High-Temperature Materials Points Way to Need for Same Insulation in Repairs

The reduction in frame sizes and the increased overload capacity made possible by motors designed for the use of Class "H" insulation have led to the increased use of materials of this type by electrical manufacturers. More and more of these motors, in which the insulation is capable of withstanding continuous operation at 175° C., are now in use throughout industry. While an outstanding characteristic of these motors is their ability to withstand high ambient temperatures or heavy overloads, it is natural that their windings may fail under conditions of severe abuse. Motor repair shops and industrial maintenance departments will therefore be faced with an increasing need to rewind these motors with the same Class "H" insulations with which they were originally wound.

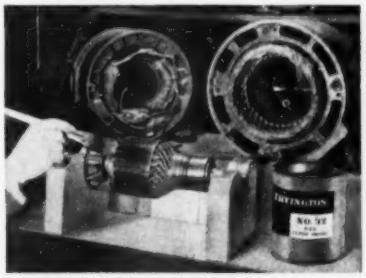


For long life at 175° C., phase coils and slot cells of this motor are insulated with Irvington Class "H" Silicone Varnished Fiberglas

Oilproof Finish Coats Improve Rewind Jobs

For extra protection of motor windings against the harmful effects of oil, grease, moisture and chemicals, a finishing coat of quick-drying enamel can be easily applied by a dip, spray or brush-on operation to windings already impregnated with Irvington Insulating Varnishes.

Irvington Red Enamel No. 32 is commonly used where fast drying time, consistent with good protection, is desired; No. 30 Red is preferred when service conditions are exceptionally severe.



Irvington Red Enamels are easily brushed on, give added protection against oil, grease, dust

Types of Class "H" Insulation

Class "H" insulation consists of inorganic materials, such as Fiberglas* or asbestos, treated with silicones or other high-temperature materials. The Irvington Class "H" insulations most commonly used in motor manufacture, and hence most commonly required in Class "H" rewinds, include:

Silicone Varnished Fiberglas, Silicone Coated Asbestos, Silicone Saturated Asbestos, Silicone Rubber Coated Fiberglas, Teflon** Coated Fiberglas, Silastic ®*** Tape, Silicone Rubber Coated Fiberglas Tubing, Silicone Coated Navabestos****.

All of these Irvington Class "H" insulating materials retain their excellent physical, chemical and dielectric properties under continuous operation at elevated temperatures.

In addition, the wide range of Irvington materials permits the rewind of Class "H" motors so that they will meet other severe operating requirements. For example, Silicone Rubber Coated Fiberglas and Silastic® Tape remain flexible at temperatures as low as —70° F. and, Silicone Varnished Fiberglas resists moisture.

Corrosive Atmospheres

For applications where corrosive atmospheres are involved, Teflon Coated Fiberglas is commonly used. This insulation possesses an exceptional degree of chemical inertness, is low in water absorption, unaffected by outdoor weathering. Send for your free copy of Irvington's Class "H" Insulation booklet.

* ®Owens Corning Fiberglas Corp., ** ®du Pont de Nemours, *** ®Dow Corning Corporation, **** ®Raybestos-Manhattan, Inc.

For further information, write the Sales Manager, Varnish Dept., Irvington Varnish & Insulator Co., 18 Argyle Terrace, Irvington, N. J.)

TOLEDO SELLS ONLY THROUGH ITS DISTRIBUTORS

No other method of distribution has ever matched Manufacturer to Distributor to User.

It's the most economical short cut to getting goods promptly to users.

Our 50 years experience in marketing the TOLEDO line of pipe tools and power pipe machines has proven this fact beyond a doubt.

Advantages for YOU!

ECONOMY—Buying many products from one source simplifies your problems of purchasing, selling, bookkeeping and storage.

SPEED—Your Distributor carries large stocks of equipment you need for immediate delivery.

RELIABILITY—Your Distributor is your friend and neighbor. Rely upon him. He serves you well.

PERSONAL CONTACT—Your Distributor's salesmen are ready at all times to help you in emergencies.

Depend on your Distributor and TOLEDO for reliable service at all times. The Toledo Pipe Threading Machine Co., Toledo, Ohio.

"TOLEDO"
Mark of Quality on Fine Pipe Tools

NECA STAFF members attending the District 1 meeting at Groton, Conn., were E. R. Cornish, director, Research & Education; S. J. Cristiano, eastern regional director; and Paul M. Geary, executive vice president.

engineers shy away from any form of lighting which might be interpreted as being local in method of application.

There are in industry, of course, many seeing tasks which are best solved by some form of local lighting. These tasks have been under study by a special Subcommittee on Supplementary Lighting, of the Committee on Lighting Study Projects in Industry, Illuminating Engineering Society. This Subcommittee has completed its report, which has been adopted by IES as its Recommended Practice for Supplementary Lighting, and forms a worthy addition to its recently published American Standard Practice for Industrial Lighting.

This new Recommended Practice deals primarily with the many critical seeing tasks involved in fabrication and inspection for manufacturing processes, and recommends lighting which supplements the general lighting systems. It covers an analysis of the seeing task, supplementary lighting equipment, and classification of visual tasks and lighting techniques.

One table classifies visual tasks and lighting techniques for each, covering both flat surfaces and three-dimensional objects. Other tables recommend proper brightness ratios and light reflectances for interior surfaces. The 16-page booklet is fully illustrated, showing a wide variety of properly lighted industrial operations including inspection of metal castings, fabrics, printing plates, paper, ball bearings, sheet metal, and others. It is published by the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y. Price is 50-cents.

Street and Highway Lighting

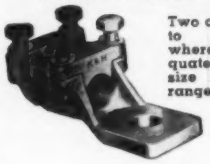
Sponsored by the Illuminating Engineering Society and approved by the American Standards Associations, a new American Standard Practice for

A Live Wire is no better than its Connections

DUPLEX LUGS

Square end—one or two attaching bolt holes. Accurately machined all contact surfaces parallel. Receives two or more conductors of different sizes with equal pressure. Wire sizes 4-1 to 900,000CM.

FLEXIBLE CABLE CLAMP LUGS



Two or four bolts, designed to meet requirements where a single lug adequately applies to several size conductors. Cover range of wire sizes from 1-1/0 to 2,000,000CM solid or stranded.

PRESSURE TYPE CAST CLAMP TERMINAL LUGS

One or two bolt holes. Lugs one piece designed for one wire size to give conductivity and contact surface equal to capacity of wire. All contact surfaces ground, faces parallel, wire sockets machined. Wire sizes 1 to 2,000,000CM.

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Porcelain Enameled
YARDLIGHTS

"Won't Blow Down" withstand wind and weather

No. 8972-8974-8976

A life-time Yardlight. Modern design—one-piece heavy gauge steel finished with three coats of Vitreous Porcelain Enamel. Completely wired and assembled. Listed by U. L.—approved for R. E. A. installation. Send for catalog.

Small Adjustable
FLOODLIGHT

7107-7110

- Residential — Commercial—Industrial for permanent or temporary installations. Heavy gauge steel construction, baked enamel finish—7½" and 10½" dia. ref. — durable, tough, weatherproof.
- Universal adjustment—install on any flat surface or attach directly to 3½" or 4" outlet box. Approved 6-foot cord and plug.
- Available immediately at your Wholesalers.

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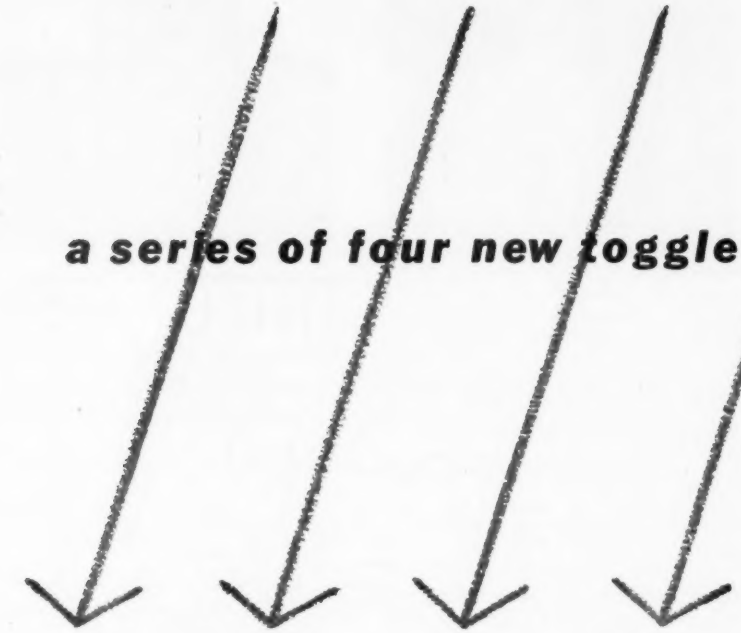
ELECTRICAL COMPANY
900-910 W. Van Buren St., Chicago 7, Ill.

a series of four new toggle switches



No. 1230 S. P.

No. 1330 S. P. (with plaster ears)

No. 1231 3-way

No. 1331 3-way (with plaster ears)

the finest switches in their class ... a new, competitively priced line, designed for durable, positive action and long, trouble-free performance.

showing new easy method of wiring

New features *include heavy duty housing with straps rivetted to bakelite cup large, staked binder head screws backed out for faster wiring, and sturdy, fast-acting mechanism with double wiping contacts*

Rated 5A.-250V., 10A.-125V.

Toggles are available in brown or ivory

Built to meet Underwriters Laboratories and Canadian Standards Association specifications

LEVITON

LEVITON MANUFACTURING COMPANY Brooklyn 22, New York • warehouses: Chicago and Los Angeles

MARTINDALE

TYPE "C" COMMSTONE HOLDER

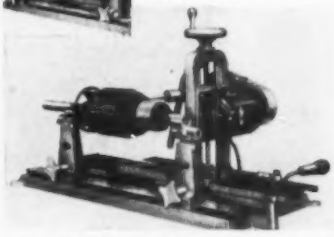
Holds Commstones rigid and true for concentric resurfacing of commutators and slip-rings while running at normal speeds in their own bearings. Grinds commutators up to 4¾" wide. Used with two Commstones in stone holder or one Commstone in 2" box.

BLOWERS and VACUUM CLEANERS

Available in 4 sizes from ½ to 1½ H.P. Suction attachments for all sizes. Write for information on other blowers.

BENCH-TYPE UNDERCUTTER

AT LEFT—Undercutting Vertical Commutator.
BELOW—Undercutting Horizontal Commutator. Note V-support at right raised to compensate for smaller shaft diameter.



Model HV-3 is a precision built, rugged, fast and accurate undercutter with a wider range of armature sizes and shaft lengths than any similar machine being built.

ADJUSTABLE BENCH GROWLER

Has adjustable jaws with face length of 2½". With jaws closed will test armatures as small as 1" diameter. With jaws open, will accommodate armatures as large as 18" diameter. Available with or without meter. Also six other models.

Write for New 64-page Catalog No. 29 describing these and many other products for industrial Maintenance, Safety and Production

MARTINDALE ELECTRIC CO.

1309 Hird Ave. Cleveland 7, Ohio

T. D. BROSS, Theodore D. Bross Co., Hartford, Conn., was chairman of the committee responsible for the program of the convention of District No. 1, NECA at Groton, Conn., June 1-3.

Street and Highway Lighting (D12.1—1953) is now available in a 32-page booklet. Evolved from 27 years of research and study, and seven previous reports—the last in 1947—, this new Standard Practice contains the latest information available on all phases of this serious lighting problem.

Liberally illustrated with tables, charts and drawings, the new Standard Practice presents the underlying principles involved in the layout and design of good street and highway lighting. It classifies according to type highways, luminaire light distribution (both vertical and horizontal) complete with detailed drawings, design of street and highway lighting, including luminaire mounting heights and positioning. Information is given on situations requiring special consideration, such as reforestation, curves and hills, intersections, grade crossings, tunnels and underpasses, and others. Tables furnish data for handy reference on classification of vehicle and pedestrian traffic as to volume, luminaire mounting heights, and recommended horizontal footcandles. Appendices give background information on fundamentals of the street lighting problem, computation of roadway illumination, measurement of factors, and glossary of terms used.

Problems of increased speeds and traffic density prevalent on today's streets and highways, with inherent increase in problems of lighting for maximum safety, are matters of national interest and concern.

The new American Standard Practice of Street and Highway Lighting provides a valuable reference for everyone concerned with the lighting of heavily travelled, multiple-lane superhighways and main thoroughfares, as well as the lighting of tunnels, underpasses, urban arteries and side streets. It is published by the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y. Price is 50-cents.

THIEL Easy-Drive **STAPLES** (Pat. #2632356)

Engineered to take punishment

. . . WON'T BEND OR SQUASH

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Contractors want these strong, rugged flat-top THIEL Staples because they save worry and waste in time and material—they don't have to "baby" them. THIEL Easy-Drive-Staples go in straight and true and are the greatest improvement in staples for cable work (metallic and non-metallic) in 25 years. Send for FREE samples—a trial will convince anyone.

THIEL EASY-DRIVE "NAIL IT" and THIEL "EASY-ON" STRAPS are another must for electrical men.

• Sold by Leading Electrical Wholesalers — write for information on open territories.

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BORE HIGH... LOW... ANYWHERE!

Fits any ½" electric drill. Uses any standard wood bit. Gears reduce speed for abundant power. Four foot shaft makes boring high, low, or in tight, hard-to-get-at places easy. Sure grip handle adjusts to any position.

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- **Saw Attachment**
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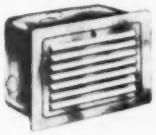
EXIT SIGNS—Surface, recessing, top and end mounting units. Metal stencil sign faces, backed by red glass. HOT-BONDED lustre aluminum finish. UL approved.



NITE LITE—One-piece, die-drawn recessing box. Louvered face with concealed hinge for easy servicing. Stainless steel or baked lustre aluminum finish. UL approved.

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PLEXOLINE® ACCENT UNITS—For use singly or with PLEXOLINE linear units. Adjustable and fixed units. Louvered body provides spill light on sides. UL approved.

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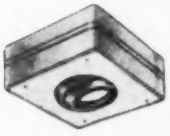

SURFACE MOUNTED ACCENT UNITS—Adjustable units or fixed units with Holophane Controlens*. May be used singly or with VIZ-AID® or LENOX® fixtures. UL approved.

RECESSING CORRIDOR UNITS—Available with two optical characteristics: asymmetric and symmetric. Flange or snap-in. Holophane* prismatic glass globe. UL approved.

*®HOLOPHANE CO., INC.

A complete line of incandescent units by Day-Brite

When the name "Day-Brite" is mentioned, you think of the nation's finest line of fluorescent fixtures. This is to remind you that there's an equally fine line of Day-Brite incandescent units—giving you the advantages of Day-Brite quality and design for every piece of equipment called for in any type of lighting job. Write for full descriptive product information on the Day-Brite incandescent line. You'll find it a valuable addition to your files.

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Lighting Fixtures

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Now Find ANY COIL SHORT Instantly!

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- POSITIVE—no chance for error
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Does away with wasted time and guesswork of hacksaw blades or vibrating reed type testers. Self-contained meter and pick-up check each coil as it is excited—once around armature, stator or rotor locates all shorts. Finds shorts that give too weak an indication to be found by other means and reveals them with a definite movement of the meter needle. Operates on 115 V, A.C. Built to highest standards of dependability and accuracy.

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DATES AHEAD

Illuminating Engineering Society — Hotel Commodore, New York, N. Y., September 14-18.

International Association of Electrical Inspectors — 25th Jubilee meeting, Edgewater Beach Hotel, Chicago, Ill., September 21-26.

Canadian Electrical Manufacturers Assn. — Annual meeting, General Brock Hotel, Niagara Falls, Ontario, Canada, September 23-25.

National Electronics Conference—9th Annual conference, Hotel Sherman, Chicago, Ill., September 28-30.

Second National Electrical Industries Show—Sponsored by the Eastern Electrical Wholesalers' Association, 69th Regiment Armory, 26th St. & Lexington Ave., New York, N. Y., September 29-October 2.

Industrial Electric Exposition — Hotel William Penn, Pittsburgh, Pa., October 6-8.

National Electrical Manufacturers Assn.—Haddon Hall Hotel, Atlantic City, N. J., November 9-12.

National Electrical Contractors Association—Annual convention, Miami Beach, Florida, November 17-20.

Electrical Progress Show—Convention Hall, 34th below Spruce Sts., Philadelphia, Pa., October 13-15.

International Association of Electrical Leagues—18th Conference, Fairmont Hotel, San Francisco, Calif., August 5-8.

National Rural Electric Cooperative Assn.—National convention, Miami, Florida, Jan. 11-14, 1954.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 8-12.

National Electrical Manufacturers Assn.—Edgewater Beach Hotel, Chicago, Ill., March 8-11.

National Association of Electrical Distributors—Annual convention, Atlantic City, N. J., Week of June 6.

FELLOW DELEGATES to NISA's national meeting included Bob Kent, Electric Enterprise Co., N. Y. C., and past-president Bill Giles, Giles Armature and Electric Works, Marion, Ill.

for the LONG PULL use Y-ER EAS Wire Pulling Lubricant

Only Y-ER EAS has all these features

Write for descriptive booklet

- Creamy, non-corrosive lubricant. Never greasy or messy.
- Prevents sticking or setting. Specially helpful on saddles and turns.
- Does not run back on cables.
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GIVES THE SLIP TO— Lead, Rubber, Braid or Synthetic Covered Cables

Improved Y-ER EAS tested and approved by the Underwriters' Laboratories, Inc.

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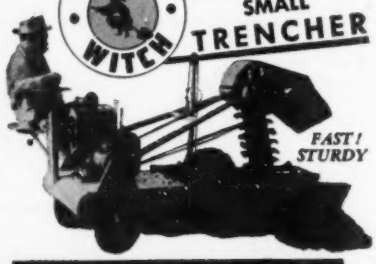
DITCH WITCH World's Best SMALL TRENCHER



4 DITCH-WITCH Models
Digs 2" to 6" Trenches
Any Depth to 36"

A self-contained ditcher operating under its own power—digs clean even 2" to 6" trenches to a 36" depth. Light weight, mobile, low operating and maintenance costs.

DITCH-WITCH used in these Industries: Construction, Maintenance, Petroleum, Railroad, Electrical, Plumbing, Municipal

PROVED IN ALL SOILS

DITCH-WITCH digs as many feet of trench as machines four times its size. Pays for itself in a few days.

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DITCH WITCH
THE CHARLES MACHINE WORKS
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BUS DUCT IS FLEXIBLE

3 men install 755 ft. of BUS DUCT in 4 days at Lapointe Machine Tool Company

Secondary power distribution for a plant expansion was no problem for Lapointe Machine Tool Company, Hudson, Mass.

Westinghouse Plug-in Bus Duct was selected—and installed in record time! Three men using a fork truck completed the 755-ft. installation *in just four days.* The savings paid for an additional lighting job.

The flexibility of plug-ins every foot saved production, too. With power taken temporarily from the duct, they moved 139 machine tools with less than five minutes down time per operator.

Prefabricated in any length up to ten feet, Westinghouse Bus Duct installs easily with sliding-type cantilever hangers. Duct is fully salvageable—can be expanded or relocated readily.

Up to 5000 amperes, Westinghouse Bus Duct has greater current-carrying capacity than any system of wireway, cable or conduit. Four types are available to handle all load conditions and service requirements.

Call your Westinghouse Representative for complete details or write for B-5835, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

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DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

PERFECT CONNECTIONS
Every Time!

Just ONE Tool
for both
SPLICING and TERMINATING
2 #18 to 3 #8 1 #16 to 1 #8

Buchanan's exclusive 4-way crimp provides pres-SURE-connections of maximum electrical and mechanical efficiency over an extremely broad range of wire sizes. Splice insulation is provided by snap-on vinyl caps of fixed insulation value.

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ELECTRICAL PRODUCTS CORPORATION
Hillside N. J.

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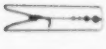
CLAMPS

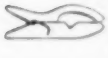
FOR THE GRIP THAT NEVER LETS GO!

Linesmen all over the country are enthusiastic about Charco's new Bulldog clamps with the improved spring—rust proof, curved to eliminate breakage, positioned for more tension. Four styles:

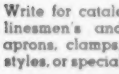
COMBINATION CLAMP . . . 5" jaws and two wire holes, designed to do job of both blanket and wire clamps.



BLANKET CLAMP . . . curved open 3½" to grip line hose and rubber blanket.



WIRE CLAMP . . . graduated holes fit securely ahead of line hose, even on sloping wire.



FLAG CLAMP . . . special oval and notched jaws grip any flat, round, square or angled object up to 3" in diameter.

Write for catalog of complete Charco line of linesmen's and industrial gloves, sleeves, aprons, clamps, safety devices. Full stock of styles, or special designs to your specifications.

CHARLESTON RUBBER COMPANY
156 Stark Industrial Park, Charleston, S. C.

COMPARATIVE COSTS of lighting to building costs over the past 30 years are presented to Minnesota electrical contractors at Minneapolis by Laurence "Duke" Johnson, illuminating engineer, Northern States Power Co., Minneapolis.

Among the Manufacturers

Headquarters Announcements

Minnesota Mining & Manufacturing Co., St. Paul, Minn.—Herbert P. Buetow, president; Dr. H. N. Stephens, vice president in charge of central research; Dr. Matthew W. Miller, business manager, central research department; Dr. Alvin M. Borders and Dr. Harold M. Scholberg, associate directors, central research department.

General Electric Co., Telechron Dept., Ashland, Mass.—M. W. Wilson, commercial engineer.

General Controls Co., Glendale, Calif.—Richard G. Ray, vice president in charge of manufacturing.

Speer Carbon Co., Speer Resistor Div., Bradford, Pa.—Clement H. Krellner, plant manager.

International Resistance Co., Philadelphia, Pa.—Walter H. Powell, director of industrial relations.

General Electric Co., Lamp Division, Cleveland, Ohio—Donald L. Millham, vice president and general manager.

J. H. Holan Corp., Cleveland, Ohio—Paul V. Dimmick, sales manager.

Lightolier, Inc., Jersey City, N. J.—Meyer Loebelson, vice president; Robert Levenstein, assistant merchandise manager, Architectural Lighting Division.

General Electric Co., Meter and Instrument Dept., Lynn, Mass.—Arthur L. Carvill, manager of electric utility field sales; Bruce B. Gravitt, manager of meter and time-switch sales; James A. Yunker, manager of instrument transformer sales; Ralph W. Drayer, manager of time switch sales.

Pittsburgh Standard Conduit Co.,

BEPCO
HEAVY DUTY MOLDED TERMINAL BLOCKS

Rated—600 Volts, 35 amperes

Check these FEATURES:

Screw and Solderless Types 4, 6, 8 & 12 Circuits

✔ MATERIAL—CFG Per MIL-P-14 A
✔ RUGGED ONE PIECE MOLDINGS
✔ HIGH REINFORCED BARRIERS
✔ MOLDED-IN RIVETS & INSERTS
✔ REVERSIBLE MARKING STRIPS

Covers and numbered marking strips also available

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ELECTRICAL PRODUCTS CORPORATION
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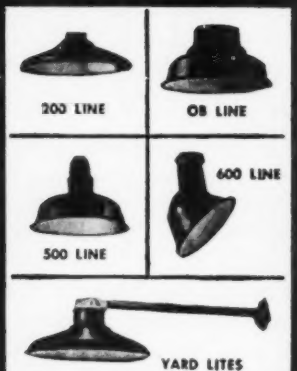
SPERO *Guaranteed
PORCELAIN ENAMEL REFLECTORS
*Guaranteed equal to any standard specification



SPERO also makes:
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CLEVELAND, OHIO

THE MAKERS OF THE WORLD-FAMOUS AMPROBE NOW BRING YOU THE

NEW AMPROBE JUNIOR

VOLT-AMP TESTER

$19.85 INCLUDING VOLTAGE TEST LEADS

ACTUAL SIZE

One pocket tester does the complete job

IT'S A SNAP-AROUND AMMETER
Measures current instantly without shutdowns or breaking of insulation for ammeter connections.

IT'S A VOLTAGE METER
Measures voltage quickly, accurately on a full-sized calibrated scale; eliminates guesswork.

Gives you tester ruggedness with instrument accuracy (within ± 3% of full scale)

PICK THE RANGE THAT FITS THE JOB:

MODEL "10": 0- 10 AMPS A-C 0-125/250 VOLTS A-C
MODEL "25": 0- 25 AMPS A-C 0-125/250 VOLTS A-C
MODEL "50": 0- 50 AMPS A-C 0-125/250 VOLTS A-C
MODEL '100": 0-100 AMPS A-C 0-125/250 VOLTS A-C

Now every electrical man can be equipped with a snap-around volt-ammeter. The Amprobe Junior is similar to the world-famous Amprobe, except that it is built to fit a specific job at low cost. For only a few dollars more than just a voltage tester, you get an *accurate* voltage meter *and* a prized snap-around ammeter. Pays for itself the first month alone by eliminating guesswork and time-wasting connections. Write today for Catalog No. 132. Pyramid Instrument Corp., Lynbrook, N. Y. (Export Div.: 458 Broadway, N. Y. 13. Cable: Morhanex).

IF YOUR JOB CALLS FOR A MULTI-RANGE AMPROBE:

AMPROBE "300"
0-6/15/30/60/150/300 AMPS AC.
0-150/300/600 VOLTS AC.
$49.50 COMPLETE WITH LEATHER CASE AND VOLTAGE TEST LEADS.

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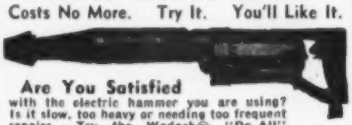

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received by July 23rd will appear in August issue, subject to space limitations.
Address copy to the Classified Advertising Division
Electrical Construction & Maintenance
330 West 42nd St., New York 36, N. Y.

Etna, Pa.—Alfred A. Snowball, vice president in charge of sales; James M. Young, vice president in charge of production; William Kretzer, vice president, Pipe Coil and Bending Division; R. R. Ruthrauff, plant manager, Etna Works; James D. Logan, plant manager of new plant at Morrisville, Pa.

Precision Transformer Corp., Chicago, Ill.—John R. Smith, Jr., sales manager.

Triangle Conduit and Cable Co., Inc., New Brunswick, N. J.—James D. Daly, director of sales, Brass and Copper Tube Division.

Bulldog Electric Products Co., Detroit, Mich.—Parker H. Stough, sales and product counselor.

United States Rubber Co., New York, N. Y.—Herbert J. Reid, assistant to the production manager, Mechanical Goods division.

Jack & Heintz, Inc.—Frank A. Haag, sales manager, commercial products; Lawrence L. Bechler, manager, commercial motor sales.

Fairbanks, Morse & Co., Chicago, Ill.—Franz F. Kaiser, chief industrial engineer.

Ramset Fasteners, Inc., Cleveland, Ohio—Clarke Tryon, sales manager.

Continental Electric Equipment Co., Cincinnati, Ohio—Charles W. Wright, administrative assistant to president.

Jefferson Electric Co., Bellwood, Ill.—John D. O'Brien, vice president in charge of sales; Frederick A. Delaney, sales service manager.

Paragon Electric Co., Two Rivers, Wis.—Jurg A. Senn, manager, Diaphragm Power Element Division.

The Clark Controller Co., Cleveland, Ohio, has acquired Fuller Johnson Corp., American Switch Corp., and Good Roads Machinery Corp., all of Minerva, Ohio.

Minnesota Mining & Manufacturing Co., St. Paul, Minn., has acquired American Lava Corp. of Chattanooga, Tenn.

Stonco Electric Products Co., Kenilworth, N. J., has purchased the Lighting Products Division of M. B. Austin Co., Northbrook, Ill.

Federal Electric Products Co., Newark, N. J., has merged with Pacific Electric Mfg. Corp., San Francisco.

Hoover Co., North Canton, Ohio, announces that its Kingston-Conley Division, North Plainfield, N. J., will henceforth be known as The Hoover Co., Electric Motor Division.

Essex Wire Corp., Detroit, Mich., announces the consolidation of its Chicago Transformer Division with Standard Transformer Corp. of Chicago, the combined operations to be known as Chicago Standard Transformer Corp. President: Addison Holton. Vice Presidents: Arni Helgason, J. J. Kahn, L. S. Racine.

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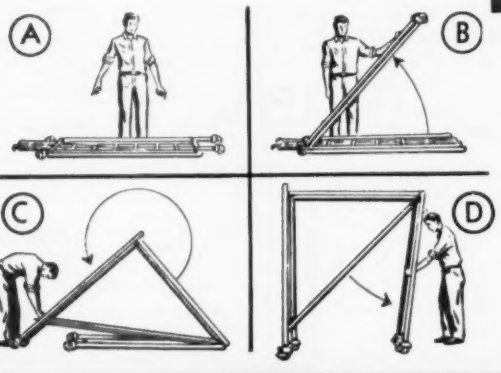

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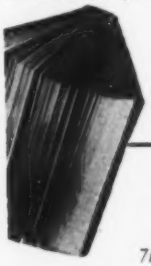

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Westinghouse Electric Corp.: T. P. Jones, manager, new branch office, Philadelphia, Pa.

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The Bristol Co.: Sam E. Gewin, district manager, St. Louis office.

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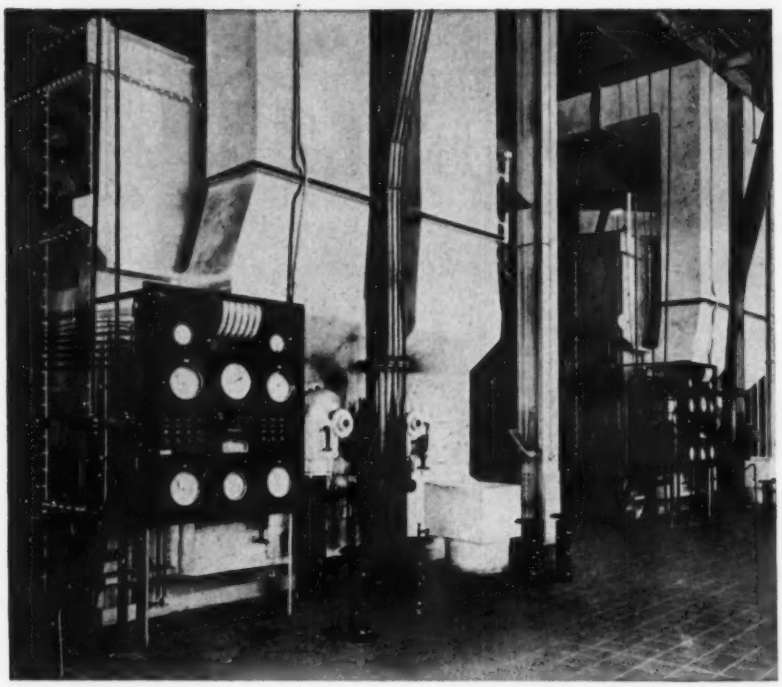

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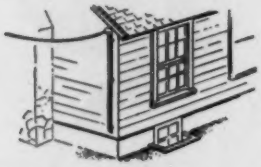

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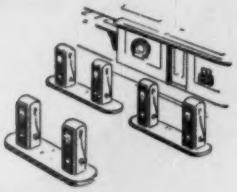

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